

**RESTRICTED**

The information given in this document is not to be communicated, either directly or indirectly, to the Press or to any person not authorized to receive it.

**War Office Code  
No. 11257**

26  
Manuals  
3835

7610-66-017-8387

**User Handbook**

**for**

**FIELD BRANCH ARTILLERY  
AMMUNITION**

**Land Service  
1958**

**THE WAR OFFICE R.A. 1.**

**January, 1958.**



**RESTRICTED**

The information given in this document is not to be communicated, either directly or indirectly, to the Press or to any person not authorized to receive it.

War Office Code  
No. 11257

26  
Manuals  
3835

**User Handbook**  
**for**  
**FIELD BRANCH ARTILLERY**  
**AMMUNITION**

**Land Service**  
**1958**

**THE WAR OFFICE R.A. 1.**  
**January, 1958.**

Record of Amendments

Amendment Serial No.	Date	A.C.I.	By whom amended	Date of Insertion

# CONTENTS

List of illustrations ... ..	Page xli
------------------------------	-------------

## Chapter 1 Introduction

### Section 1. General

Scope ... ..	1
Objects ... ..	1
Arrangements ... ..	1

### Section 2. Definitions associated with Equipments

Guns, howitzers and mortars ... ..	1
Classification ... ..	2
Means of firing ... ..	2
Means of initiation ... ..	3
Safety devices ... ..	3

### Section 3. Field Branch Artillery Equipments

Loading ... ..	3
----------------	---

### Section 4. The Round of Ammunition

Future designation and marking ... ..	3
Components ... ..	4
Cartridge ... ..	4

### Section 5. Categories of Ammunition

General ... ..	6
----------------	---

## Chapter 2 Explosives

### Section 1. Introduction

Classification of explosives ... ..	7
Definitions ... ..	7
Uses ... ..	10

Section 2. Propellants

Page

General ... ..	10
Historical ... ..	10
Burning of a propellant ... ..	10
Properties of the ideal propellant ... ..	11
Composition ... ..	12
Characteristics ... ..	12
Flash and Smoke ... ..	14
Properties of the commoner propellants ... ..	15
Nomenclature ... ..	15
Multiplicity of propellant ... ..	18

Section 3. High Explosives

Definition ... ..	18
Compositions ... ..	20
Categories ... ..	20
Bursting charges - i.e. shell fillings ... ..	21
Constituents ... ..	21
Code for H.E. fillings ... ..	21
Initiators (disruptive) ... ..	21
Constituents ... ..	22
Intermediates ... ..	22
T.N.T. ... ..	23
Constituents ... ..	23

Section 4. Miscellaneous Compositions

General ... ..	23
Initiating agents (igniferous) ... ..	24
Smoke producing substances ... ..	24
Flare producing substances ... ..	26
Conclusions ... ..	26

Chapter 3  
Cartridges

Section 1. Introduction

Classification and comparison ... ..	27
Comparison of Q.F. (separate loading) and B.L. cartridge systems ... ..	27
Cartridge case ... ..	27
Cartridge bag ... ..	28
Propellant charge ... ..	28
Charge - types ... ..	30
Propellant proof and charge adjustment ... ..	30

Section 2. Q.F. Cartridges

General ... ..	31
Sub-division of cartridges ... ..	31
Design of cartridges ... ..	31

	Page
Section 3. Types of Q.F. (Separate loading) Cartridges used in Field Branch Artillery Equipments	
Q.F. 25 pr. gun ... ..	32
Normal charges ... ..	32
Super charges ... ..	32
Increment charges ... ..	34
Issue and preparation ... ..	34

Section 4. B.L. Cartridges

General ... ..	35
Sub-division of cartridges ... ..	35
Materials ... ..	35
Diameter and length ... ..	35
Design of B.L. howitzer and gun/howitzer cartridges ... ..	36
Arrangement of howitzer and gun/howitzer cartridges ... ..	36

Section 5. Types used in Field Branch Artillery Equipments

B.L. 4.5 in. gun ... ..	37
B.L. 5.5 in. gun ... ..	37
B.L. 7.2 in. howitzer ... ..	39

Chapter 4  
Means of Ignition

Section 1. Introduction

Ignition of the propellant charge ... ..	41
--	----

Section 2. Primers

General ... ..	41
Percussion - description ... ..	41
Action ... ..	43

Section 3. Tubes

General ... ..	43
Percussion, S.A. cartridge ... ..	43
Action ... ..	43

Section 4. Igniters

General ... ..	44
----------------	----

## Chapter 5 Projectiles

### Section 1 Introduction

Page

General ... ..	45
Component details ... ..	46
Projectiles - definitions ... ..	48

### Section 2 The Shell

General ... ..	50
High explosive shell ... ..	50
Shell H.E. Nosed fuzed ... ..	50
Shell, H.E. base fuzed ... ..	52
Carrier, shell ... ..	52
Shell, smoke, B.E. ... ..	52
Containers, smoke ... ..	54
Shell plugs in coloured smoke containers ... ..	54
Shell, flare ... ..	54
Shell, incendiary, B.E. ... ..	54
Shell, chemical, B.E. ... ..	54
Shell, star, B.E. ... ..	54
Practice projectiles ... ..	55

### Section 3 Shot

General ... ..	55
Armour piercing ... ..	55
Armour piercing capped ... ..	55
Practice ... ..	56
Proof ... ..	56
Paper ... ..	56

## Chapter 6 Fuzes

### Section 1. Principles etc.

Introduction ... ..	57
Forces ... ..	57
Mechanical devices ... ..	58
Other fuze components ... ..	64

### Section 2. Types

Time fuzes ... ..	66
Time and percussion fuzes ... ..	67
Percussion fuzes ... ..	67
Base fuzes ... ..	67
Proximity or variable time (V.T.) fuzes ... ..	67



Section 3. Fuzing Procedure

	Page
General ... ..	68
Examination of fuzes ... ..	68
Nature of shell normally issued fuzed or plugged ... ..	70
Instructions for fuzing ... ..	70
Preparation for firing ... ..	73
Prepare shell for return to vehicle ... ..	74

Section 4. Care, Preservation, faulty Ammunition and Prematures

Care of fuzes ... ..	74
Preservation ... ..	75
Faulty ammunition ... ..	75
Prematures ... ..	76
Defective fuzes ... ..	76
Unserviceable fuzes ... ..	76

Chapter 7

Tracers and Tracer - and - Igniters

Section 1. General

Introduction ... ..	77
Classification ... ..	77

Section 2. Tracers, Shell

Description ... ..	77
Action ... ..	79

Section 3. Tracer-and-Igniters, Shell

Description ... ..	79
Action ... ..	80

Section 4. Integral Tracers

Description ... ..	80
--------------------	----

Chapter 8

Cartridges, Blank and Paper Shot

Section 1. Introduction

General ... ..	81
----------------	----

Section 2. Types authorised for Field Branch Artillery Equipments

	Page
Cartridge, blank ... ..	81
Precautions to be observed when firing blank ammunition ... ..	82
Cartridge, paper shot ... ..	82

Chapter 9  
Drill Ammunition

Section 1. Introduction

General ... ..	83
----------------	----

Section 2. Components

Drill cartridges ... ..	83
Drill projectiles ... ..	86
Drill fuzes ... ..	87
Drill primers ... ..	87
Drill tubes - S.A. percussion ... ..	88

Chapter 10  
4.2 inch Mortar Ammunition

Section 1. Introduction

Equipment ... ..	89
Ammunition ... ..	89
Waterproofing and rustproofing ... ..	90
Clips safety pin special ... ..	90
Cover, tail, M.L. 4.2 in. mortar ... ..	90
Spring, retaining cartridge augmenting ... ..	90
Means of ignition ... ..	90

Section 2. Bombs

Bombs, S.B. M.L. H.E. streamline ... ..	91
Practice bombs ... ..	92

Section 3. Propellant Charges

Primary cartridges ... ..	92
Augmenting cartridges ... ..	94
Drill cartridges (primary and augmenting) ... ..	94

## Chapter 11 Records

### Section 1. Purpose and Application of the Lotting System

	Page
Introduction ... ..	95
Propellants ... ..	95

### Section 2: Purpose and Application of the Batching System

Introduction ... ..	95
Purpose of batching ... ..	95
Batching system ... ..	96
Application of batching system ... ..	96
Identification of batches and sub batches ... ..	97
Ammunition and package markings ... ..	98

## Chapter 12 Identification Colours and Markings

### Section 1. Introduction

General ... ..	99
Forms and applications ... ..	99

### Section 2. Cartridges

Method of colour identification and markings ... ..	100
Additional means of identification ... ..	105
Mortar cartridges ... ..	105

### Section 3. Projectiles, Fuzes and Tracers

Projectiles ... ..	106
Stencilling ... ..	110
Mortar bombs ... ..	117
Fuzes ... ..	117

### Section 4. Packages

Method of colour identification and markings ... ..	118
---	-----

## Chapter 13 Associated Publications

Associated publications ... ..	131
--------------------------------	-----

### Appendix A

Page

Various types and uses of explosives ... ..	133
---	-----

### Appendix B

Propellant compositions ... ..	134
--------------------------------	-----

### Appendix C

Composition of intermediaries and initiating explosives ... ..	136
--	-----

### Appendix D

Code indicating high explosive with composition and percentages of ingredients ... ..	138
---	-----

### Appendix E

#### Details of Ammunition authorized for Field Branch Artillery Equipments

##### Part 1. Q.F. 25-PR. Gun Ammunition

Projectiles ... ..	140
Cartridges ... ..	140
Fuzes ... ..	142
Primers ... ..	142
Shell, Q.F. 25 pr. chemical B.E. ... ..	143
Shell, H.E. streamline ... ..	143
Shell, H.E. screening smoke ... ..	144
Shell, streamline, B.E. coloured smoke ... ..	145
Shell, flare, T.R.B.E. ... ..	145
Shell, streamline, B.E. incendiary ... ..	145
Shell, star ... ..	145
Shot, A.P.C. ... ..	145
Shot, practice ... ..	145

##### Part 2. B.L. 4.5-inch Gun Ammunition

Projectiles ... ..	145
Cartridges ... ..	146
Fuzes ... ..	146
Igniters, auxiliary ... ..	146
Shell, H.E. streamline ... ..	146
Tubes ... ..	147

Part 3. B.L. 5.5-inch Gun Ammunition

	Page
Projectiles ... ..	147
Cartridges ... ..	147
Fuzes ... ..	148
Igniters, auxiliary ... ..	148
Shell, H.E. ... ..	148
Shell, H.E. streamline ... ..	149
Shell, flare, T.R.B.E. ... ..	149
Shell, B.E. incendiary ... ..	150
Shell, B.E. smoke ... ..	150
Tubes ... ..	150

Part 4. B.L. 7.2-inch Gun Ammunition

Projectiles ... ..	150
Cartridges ... ..	151
Fuzes ... ..	151
Shell, H.E. streamline ... ..	151
Tubes ... ..	152

Appendix F  
Particulars of Fuzes

Fuze, percussion, D.A., No.117 ... ..	153
Fuze, percussion, D.A. and graze, No.119 ... ..	159
Fuze, time and percussion, D.A., No.213 ... ..	164
Fuze, time and percussion, graze, No.221 and No.221B ... ..	168
Fuze, percussion, base medium, L 15 ... ..	172
Fuze, percussion, D.A., No.162 ... ..	176
Fuze rocket, 3.5 in. UK M 20 - fuzed percussion M16 ... ..	180

Appendix G  
Particulars of Primers

Primers, percussion, Q.F. cartridges, No.1 ... ..	185
Primers, percussion, Q.F. cartridges, No.9 ... ..	187
Primers, percussion, Q.F. cartridges, No.11 ... ..	189

Appendix H  
Particulars of Tracers

Tracers, shell, No.2 ... ..	191
Tracers, shell, No.37 ... ..	193

Appendix J  
Particulars of Tubes

Tubes, percussion, S.A. cartridge ... ..	195
--	-----

## List of Illustrations

	Page
Fig. 1 Types of ammunition ... ..	5
2 Propellant shapes ... ..	13
3 Use of initiators, intermediaries and bursting charges ... ..	19
4 Section thro' typical cartridge case ... ..	28
5 Typical propellant charges ... ..	29
6 Typical examples - separate loading cartridges - Q.F. 25 pr. ... ..	33
7 B.L. 4.5 in. Gun cartridge ... ..	37
8 B.L. 5.5 in. Gun cartridge ... ..	38
9 B.L. 7.2 in. howitzer cartridge ... ..	40
10 Typical percussion primer ... ..	42
11 Typical percussion tube ... ..	43
12 Typical C.R.H. (calibre radius head) design ... ..	47
13 Typical driving band and alternative baseplates ... ..	48
14 Projectile definitions ... ..	49
15 Typical H.E. (high explosive) nose fuze shell ... ..	51
16 Typical B.E. (base ejection) carrier shell ... ..	53
17 Method of functioning, base ejection star shell ... ..	55
18 Typical A.P. (armour piercing) shot ... ..	56
19 Holding devices ... ..	59
20 Holding devices ... ..	60
21 Masking devices ... ..	61
22 Masking devices ... ..	62
23 Firing devices ... ..	63
24 Firing devices ... ..	64
25 Detonators ... ..	65
26 Magazine and channels ... ..	65
27 H.E. shell fuze-hole plugs ... ..	69
28 H.E. shell suitable for standard fuzes, plugged with No.13 (or L2A1) and No.3 fuze hole plugs ... ..	71

	Page
Fig. 29 H.E. shell suitable for V.T. fuzes only, plugged with No.29 (or L4A1) fuze hole plugs	72
30 H.E. shell suitable for V.T. or standard fuzes, plugged with No.13 (or L2A1) fuze hole plugs ... ..	72
31 Shell, B.E. (smoke etc.) plugged with No.1 fuze hole plug ... ..	73
32 Method of setting time or time-and-percussion fuzes ... ..	74
33 Types of shell tracers ... ..	78
34 Typical shell tracer-and-igniters ... ..	79
35 Typical integral tracer fillings for shot ... ..	80
36 Types of blank cartridges ... ..	82
37 S.B. M.L. 4.2 in. mortar bcmb ... ..	89
38 Method of retaining primary cartridge in S.B. M.L. 4.2 in. mortar bomb ... ..	90
39 Method of filling S.B. M.L. 4.2 in. mortar bomb ... ..	91
40 Primary cartridge and augmenting cartridge for S.B. M.L. 4.2 in. mortar bomb ...	93
41 Identification markings for 25 pr. cartridges ... ..	101
42 Additional stencilling to indicate charges designed for special purposes ... ..	101
43 Examples of identification markings on B.L. cartridges ... ..	103
44 Coloured rings, bands and stripes, etc., on projectiles ... ..	109
45 Typical identification markings for H.E. filled shell ... ..	113
46 Typical identification markings for smoke shell ... ..	114
47 Typical identification markings for flare shell and star shell ... ..	115
48 Typical identification markings for incendiary shell ... ..	116
49 Typical identification markings for A.P. (armour piercing) shot ... ..	116
50 Latest approved identification markings for steel box for separate loading shell ...	120
51 Latest approved identification markings for steel box with inner containers ... ..	122
52 Latest approved identification markings for wood box with inner containers ... ..	124
53 Latest approved identification markings for wood box with inner containers ... ..	126
54 Latest approved identification markings for steel box for bulk packed fuzes ... ..	130
55 Shell, Q.F. 25 pr., chemical, B.E. ... ..	143
56 Fuze, percussion, D.A., No.117, mark 18 ... ..	154
57 Fuze, percussion, D.A., and graze, No.119B, mark 17 ... ..	160
58 Fuze, time and percussion, D.A., No.213, mark 4 ... ..	166
59 Fuze, time and percussion graze, No.221B, mark 4 ... ..	169
60 Fuze, percussion, base, medium, L15A1 ... ..	173

	Page
Fig. 61 Fuze, percussion, D.A., No.162, mark 3/3 ... ..	177
62 Fuze, percussion, L16A1 (Part 1) ... ..	182
63 Fuze, percussion, L16A1 (Part 2) ... ..	183
64 Primer, percussion, Q.F. cartridges, No.1, mark 2 ... ..	185
65 Primer, percussion, Q.F. cartridges, No.9, mark 4 ... ..	187
66 Primer, percussion, Q.F. cartridges, No.11, mark 4/1 ... ..	189
67 Tracer, shell, No. 2, mark 7 ... ..	191
68 Tracer, shell, No.37, mark 1 ... ..	193
69 Tube, percussion, S.A. cartridge, mark 5 ... ..	195



NOTE

Information relating to details of individual charges, projectiles and their packages, etc., will be found in:-

Regs. for Army Ordnance Services Volume 4. Ammunition  
Pamphlet No. 6. (B.L. ammunition)  
Pamphlet No. 7. (Q.F. separate ammunition)  
Pamphlet No. 11 Part 1 (3.5 inch Rocket Ammunition)  
Pamphlet No. 12 Part 3 (Ammunition for the Ordnance M.L.  
4.2 inch Mortar)

FOR DETAILS OF RESTRICTIONS IMPOSED ON THE USE OF SPECIFIC MARKS OF FUZES FOR TRAINING AND EQUIPMENTS ASSOCIATED WITH SPECIFIC MARKS OF FUZE see:-

"LIMITATIONS IN THE USE OF FUZES FOR TRAINING 1955  
W.O. CODE No. 11233."

## Chapter 1 Introduction

### Section 1. General

#### SCOPE

1. Primarily Field Branch Artillery ammunition, but it also embraces ammunition used in the secondary role of Anti-Tank Artillery.

#### OBJECTS

2. Promotion of a fuller understanding of all aspects.  
Presentation of essential data for easy reference.  
Provision of detailed information on components.  
Provision of information on assembly, purposes of various combinations with descriptions of actions.

#### ARRANGEMENTS

3. Body of notes:- Consideration of broad and general principles.  
Appendices:- (Data in tabular form.  
(Detailed descriptions with illustrations of current Service components.

4. As indicated by the title, this pamphlet is essentially a user handbook on everything concerning Field Branch Artillery ammunition. Although containing very complete detailed information in the Appendices, a study of the whole publication should not only enable the details to be understood but should also assist in the understanding of other British as well as foreign ammunition for which detailed particulars may not be available.

## Chapter 1 Introduction

### Section 2. Definitions associated with Equipments

#### GUNS, HOWITZERS AND MORTARS

5. These are equipments which all have the following properties:-

(a) That give projectiles specified initial velocity and direction of motion.

(b) They do so by the rapid burning of a propellant charge in a chamber, producing gas under pressure which forces the projectile to move along a barrel (also called "bore" or "piece").

There are no sharp distinguishing features between guns, howitzers and mortars. Certain general differences may, however, be noted.

6. Guns - These generally produce higher muzzle velocities, flatter trajectories with a smaller angle of descent and have fewer charges than howitzers; apart from these there are no essential ballistic differences between the two.

7. Howitzers - Compared with guns these have a higher trajectory, and steeper angle of descent, with variable charges, thus enabling engagement of targets behind intervening crests.

For relatively the same total weight of equipment, howitzers have a larger calibre, shorter barrel and shorter range, a lower muzzle velocity, very high elevation and fire a heavier shell with higher H.E. content than guns.

8. Gun/howitzer (combined weapons) - This is a gun of a calibre intermediate between the gun and howitzer that it replaces and it has a variable charge. Muzzle velocities are in general slightly lower than the older guns but maximum ranges are usually slightly greater due principally to improved shell design. Shell weights are usually lower than for howitzers. Thus:-

	25 pr.	(cal. 3.45 inch	Range 13,000 yds.)
Replaces	18 pr. gun and	(cal. 3.3 inch	Range 9,000 yds.)
	4.5 inch howr.	(35 lb. shell	Range 6,000 yds.)
	5.5 inch gun	(80 lb. shell	Range 18,000 yds.)
Replaces	60 pr. gun and	(cal. 5 inch	Range 14,000 yds.)
	6 inch howr.	(100 lb. shell	Range 9,000 yds.)

9. Mortars - These are small, light and easily handled equipments propelling projectiles with low velocities at high angles of elevation. They are usually loaded through the muzzle, whereas guns and howitzers are loaded through the breech. They usually have smooth bores, whereas guns and howitzers have rifled bores. They are normally fired at high angle.

#### CLASSIFICATION

10. In the past equipments were classified by the means of the obturation employed. "Obturation" is used to describe the sealing of the rear end of the chamber against propellant gases escaping rearwards.

11. Q.F. ordnance - The propelling charge is contained in a brass or steel cartridge case, the case providing the means of obturation.

There are two types:-

- (a) Fixed - The case is firmly attached to the projectile and the whole assembled round is loaded as a unit. Loading is quick but it is not possible to vary the propellant charge without changing the complete round.
- (b) Separate - The cartridge case is entirely separate and the projectile is rammed home before the cartridge case is loaded. The charge in the case is variable.

12. B.L. ordnance - The charge is contained in a cloth bag, to the breech end of which a gunpowder igniter is fitted. Obturation is obtained by a resilient pad assembled on the front face of the breech mechanism and sealing the rear end of the chamber.

#### MEANS OF FIRING

13. The breech mechanism of a gun or howitzer carries the means of firing. They may be percussion or electric although, at the time of writing, all Field Branch Artillery equipments have percussion breech mechanisms.

14. Percussion - The striker of the mechanism is driven on to the percussion cap assembled centrally in the base of the primer or tube. The initiating composition in the cap is nipped on an anvil and the resultant flame ignites gunpowder in the body or magazine of the primer or tube which in turn ignites the main propellant charge.

15. Electric - On contact being made the electric current passes from the battery or dynamo, through the firing pin of the breech lock to the contact piece assembled centrally in the base of the primer or tube, along the insulated wire in the copper plug, through the iridio-platinum bridge to the small copper pole and the body of the tube or primer, and back, via the gun, to the battery. The bridge becomes incandescent, ignites the gun-cotton dust which, in turn, ignites the gunpowder in the magazine, the resultant flame ignites the cloth igniter attached to the base of the propellant charge, and then the charge itself.

#### MEANS OF INITIATION

16. Q.F. guns - The initiator is contained in a primer assembled in the base of the cartridge case. The primer contains its own means of obturation.

17. B.L. guns - The initiator is contained in a small brass case known as a tube, which is loaded separately into a chamber in the rear of the breech mechanism. This chamber is connected by a flash channel to the chamber of the gun.

On firing, the flash passes along this channel, on to a gunpowder igniter attached to the rear end of the cartridge, which in turn ignites the main propellant charge.

The tube provides its own obturation on the Q.F. principle and is supported by a lock working in a slide box, which together form in effect a miniature sliding breech block and firing mechanism.

#### SAFETY DEVICES

18. These are incorporated in breech and firing mechanisms to prevent the gun from being fired before the breech is fully closed.

## Chapter 1 Introduction

### Section 3. Field Branch Artillery Equipments

19. These equipments may be self-propelled or towed. The guns and howitzers may be of the Q.F. type or of the B.L. type.

#### LOADING

20. Q.F. guns may be either fixed or separate loading, while Q.F. howitzers are separate loading only.

With fixed ammunition the projectile is assembled to the cartridge case and loaded as one unit, whereas with ammunition for Q.F. separate loading guns and howitzers the projectile is first loaded and rammed, followed by the cartridge.

With B.L. guns and howitzers the round is always loaded separately. Field Branch Artillery Q.F. and B.L. guns and howitzers are separate loading mainly because the complete round is difficult to transport and handle, and also because it affords facilities for varying the propellant charge.

## Chapter 1 Introduction

### Section 4. The Round of Ammunition

#### FUTURE DESIGNATION AND MARKING

21. New designs of ammunition - A model number followed by the letter "A" and a serial number will be adopted in nomenclature and markings in lieu of a number and mark previously used to identify the store. Where, however, new patterns of existing stores are introduced, the number and/or mark will continue to be advanced as heretofore.

22. Ammunition for new equipments - All references to the method of obturation such as "B.L.", "Q.F.", "R.C.L.", etc., will be omitted from primary nomenclatures and markings. When, however, it is required to differentiate between two weapons of similar calibre but of different role and design, a reference to the role will be incorporated to make identification complete. Typical examples although not Field Branch Artillery equipments are:-

120 mm. L2 BAT.  
120 mm. L1 Tk.

23. Fixed ammunition (projectile cum case) for new equipments - The term "round" in lieu of "cartridge" will be used to designate the complete assembled store, in both nomenclature and markings. Where, however, new patterns of existing Q.F. fixed ammunition are introduced, the term "cartridge" will continue to be used.

#### COMPONENTS

24. The main components of a complete Q.F. round are the cartridge case, primer, propellant charge, projectile and (for other than shot) a fuze, and those of a B.L. round, the cartridge (in a cloth bag), tube, projectile and fuze.

25. Cartridge case (Q.F. ammunition) - This is normally of brass and serves to obturate the chamber of the gun, contain and protect the propellant, support the primer and any additional ignition required, and finally, in the case of a fixed round, to unite the propellant section to the projectile.

26. Cartridge (B.L. ammunition) - This normally consists of a propellant charge which is enclosed in a cloth bag, the end of which is loaded nearest the breech being fitted with a cloth igniter filled with gunpowder.

27. Primer - This is normally of metal and screwed into the centre of the base of the cartridge case. On the primer cap being struck by a mechanically operated striker or fired electrically, it serves to produce a flash to ignite the gunpowder in the primer magazine and alone or in conjunction with an additional igniter in the cartridge, produces sufficient flash adequately to ignite the propellant charge.

28. Tube - This is similar in design to an unbulleted S.A.A. round. There are several types differing mainly in size, and method of ignition i.e. percussion and electric. On the cap being struck by a mechanically operated striker or fired electrically it produces a flash to ignite the gunpowder in the body (or magazine) of the tube which, in turn, ignites the gunpowder igniter at the rearward end of the propellant charge. They are used mainly in B.L. guns and howitzers being fitted in a vent in the firing mechanism. Electric tubes are not, at present, used with any Field Branch Artillery weapons.

29. Propellant charge - This consists usually either of cordite or of a nitrocellulose propellant. The charge may also include a decoppering agent consisting of a small amount of tin and/or lead usually in the form of foil, positioned as nearly as possible immediately in the rear of the projectile.

30. Fuzes - These are designed to fulfil a specific purpose such as time, direct action percussion, graze or delay and may be made to be assembled either in the nose or base of the projectile. In some designs the fuze may combine the dual purpose of, say, time and D.A. percussion etc.

31. Projectiles - These may be either solid (shot) or hollow (shell) the latter being filled with explosive or other substance, such as smoke, flare, incendiary compositions, etc. In the case of shell a fuze and/or a shell igniter is fitted to initiate the filling. Both shot and shell may be fitted with a tracer to give a visible "trace" of the path of the projectile in the sky.

32. Lids and cups - Certain Q.F. cartridges are assembled with a lid or cup in the mouth of the case. The object of these components is to prevent ingress of moisture, prevent portions of the charge being dislodged from the case when being loaded, and also to prevent the charge moving forward away from the means of ignition, i.e. the primer.

#### CARTRIDGE

33. Q.F. fixed ammunition (Fig. 1) - With this ammunition, the projectile is firmly attached to the cartridge case and thus the projectile, cartridge case, propellant charge (which cannot be varied) and the primer constitute a single entity termed the "cartridge". Incidentally, the cartridge may be issued and/or stored either plugged or with the fuze assembled. When demanding such ammunition it will be necessary, therefore to specify the particular type and nature of fuze required and the type of cartridge i.e. S.V., full or reduced charge.

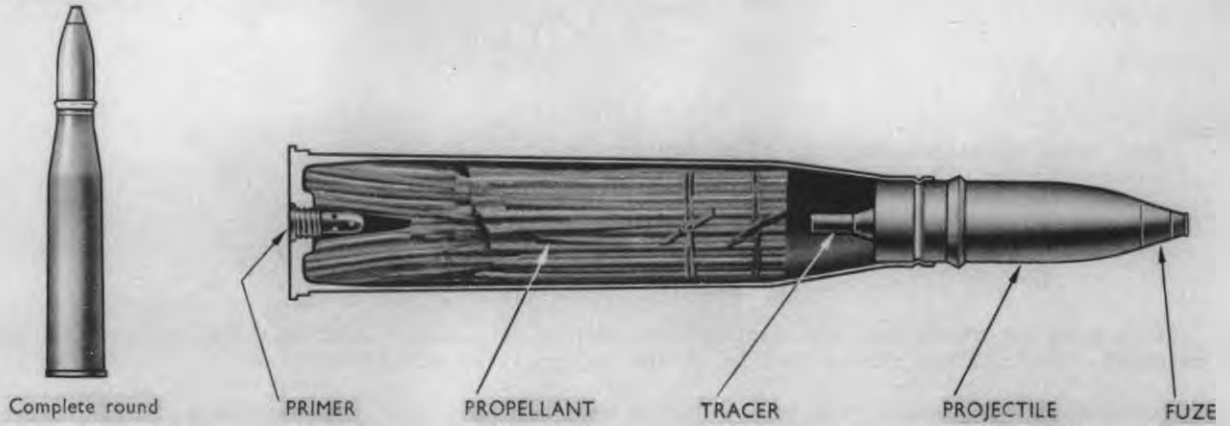
34. Q.F. separate loading ammunition (Fig. 1) - In this instance, the projectile and cartridge are separate stores, the "cartridge" consisting only of the cartridge case, propellant charge and primer. The projectile and fuze are separately demandable.

35. B.L. ammunition (Fig. 1) - This consists of the cartridge (or charge) which is contained in a cloth bag, a projectile, a fuze and a tube, all of which are separately packed, stored and demandable. The term "round" is not normally used when referring to this nature of ammunition. Here again, when demanding such ammunition it will be necessary to specify the particular type and nature of fuze, the type of charge i.e. super, full, 1/2 charges, etc. and the size and type of tube i.e. percussion or electric, required.

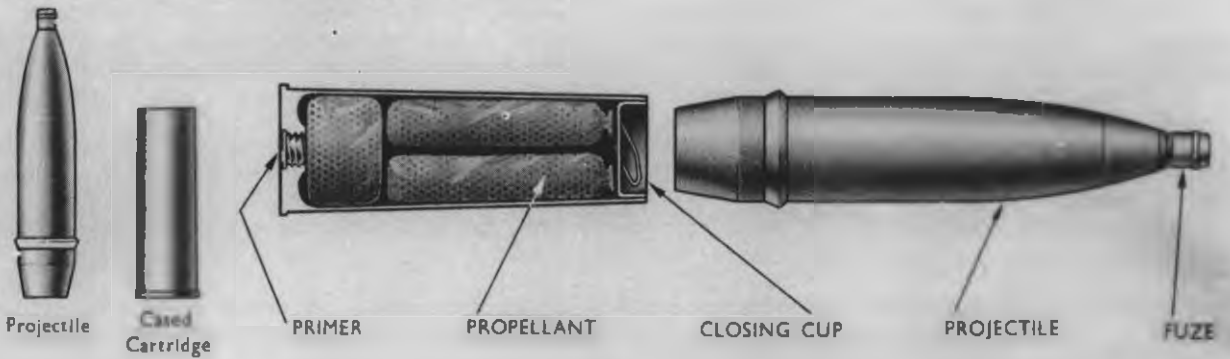
# TYPES OF AMMUNITION

FIG. 1

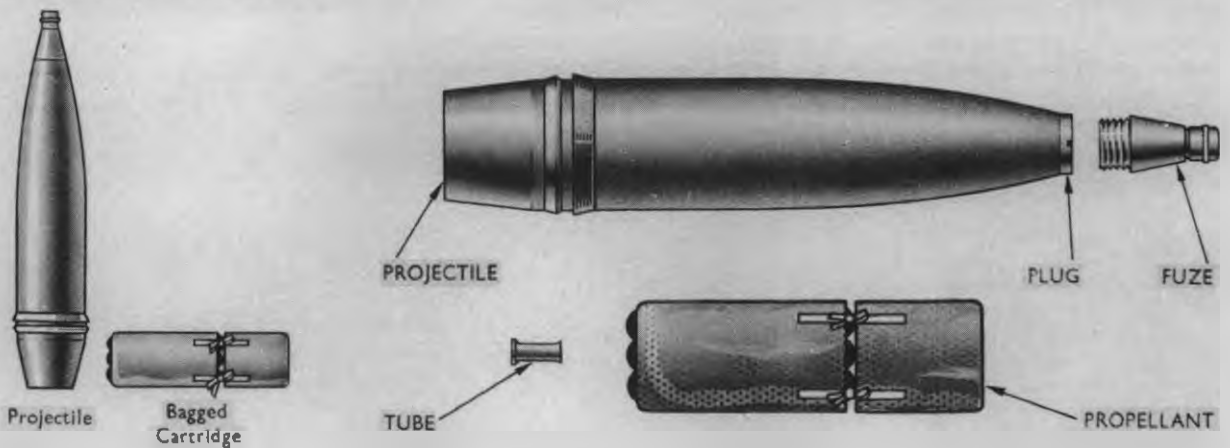
## TYPICAL FIXED AMMUNITION



## TYPICAL Q.F. SEPARATE LOADING AMMUNITION



## TYPICAL B.L. AMMUNITION



## Chapter I Introduction

### Section 5. Categories of Ammunition

#### GENERAL

36. There are four main categories of ammunition:-

- Operational
- Practice
- Blank
- Drill

It is most important that the distinctions should be clearly understood and recognised. Only one category of ammunition should ever be on the gun position at any one time.

37. Operational - All ammunition components in this category i.e., the cartridge, projectile, fuze and tube, are "LIVE" and the projectile is primarily lethal, although such non-lethal items as smoke, star and flare shell are necessarily included.

38. Practice - Ammunition in this category is for practice firing, i.e., for effect in simulated combat and is provided for training in marksmanship and observation.

The components are "LIVE". The projectile, however, is less lethal than its operational equivalent. In the case of shell or practice projectile it may contain only a small quantity of low explosive filling or in the case of shot the nose may be truncated or may not be specially hardened. To effect economy in costs and labour such projectiles may also be manufactured from a lower grade of material than is a requirement for their operational versions.

Such projectiles are designed to inflict the minimum of damage to the practice target or area, while at the same time permitting accurate ranging to be achieved and enabling the point of impact to be observed.

Except for the projectile, all other components are identical with those used for the equivalent operational round.

39. Blank - This is used for demonstrations and saluting purposes. It consists of a cartridge case or bag containing only a charge, usually of gunpowder although cordite charges have been approved for some equipments.

40. Drill - All drill ammunition is completely INERT and is used for practice in handling and drill of loading, fuzing, etc. In shape, dimensions and weight it is similar to the equivalent Service store.

## Chapter 2 Explosives

### Section 1. Introduction

#### CLASSIFICATION OF EXPLOSIVES

41. For military purposes explosives may be divided into:-

- Propellants
- High explosives
- Miscellaneous, including gunpowder, pyrotechnic and other compositions that cannot usually be detonated.

Propellants are explosives which are not normally intended to do more than explode. High explosives are those that are capable of being detonated, and are normally used for that purpose. They may be sub-divided for gun ammunition purposes into:-

- (a) Shell fillings, which are very insensitive and difficult to detonate;
- (b) Initiating agents, which are very sensitive, and detonate quite easily; and
- (c) Intermediaries, which are used to pick up the small but concentrated shock given by the initiator and transform it into a sufficiently violent wave to detonate the main filling.

#### DEFINITIONS

42. Explosives are substances which, on being suitably initiated, decompose rapidly, yielding a large quantity of gas. They are capable of exerting a sudden and intense pressure on their surroundings. The resulting disturbance may be either an "explosion" or a "detonation".

A sound knowledge of the explosives used in Field Branch Artillery ammunition is essential to a proper understanding of the principles of care and maintenance, as is also some knowledge of the metals used for explosive containers such as shells, magazines, etc.

43. Explosion - This may be regarded as a rapid combustion, which occurs in the absence of atmospheric oxygen, and is characterised by the evolution of heat, flash and sound, and by the rapid decomposition of the substance, forming large quantities of gas. The rate of decomposition is, however, comparatively slow when compared with the extremely rapid decomposition of detonation. It may be between 0.3 and 300 metres per second and depends to a great extent on the surrounding temperature and pressure. When an explosive such as cordite is ignited it burns from the surface inwards in parallel layers with a velocity which depends on the pressure, but which, even under several thousand atmospheres, never exceeds a few metres per second. The ignition is communicated from layer to layer by the heat generated, and the hotter the explosive is before ignition, the less heat is required to ignite it and the less time it takes to burn from layer to layer.

Thus with an explosion, the explosive is converted into gas by burning which progresses comparatively slowly and regularly and exerts a sustained pressure on the container. This pressure builds up until "something goes".

In the case of a propellant charge, this is the projectile which is forced up the bore of the gun, neither projectile nor gun being damaged.

If the explosive is confined in a sealed container, such as a shell, this will fracture at its weakest points into a few large fragments. The actual fractures are comparatively clean and normal to the surface.

The principal explosives of this type are the cordites, nitrocellulose propellants and gunpowder. These explosives if insufficiently confined will only burn, and this fact is made use of in various powder trains for fuzes, tracers etc.

44. Detonation - With a detonation the conversion into gas is by a disruptive and almost instantaneous wave action which shatters the container into a large number of small fragments travelling at great speed and therefore with great penetrative power. These fragments are themselves evidence of the disruptive action, being jagged and split.

The explosives that are capable of being detonated are known as high explosives. Unless there is efficient initiation and transmission of the detonating wave, however, a partial detonation, explosive, or burning only will result.

45. Velocity of detonation - This varies from 3,000 metres/sec. to over 8,000 metres/sec. with Service high explosives. Rates for some of the commoner high explosives are given below:-

DESIGNATION	V. of D. metres/sec.	Melting point °C	Ignition point °C
Fulminate of mercury	4,500 at density 3.3 gm/c.c.	-	about 170°
Lead azide	4,500 " 3.8 "	-	" 350°
Amatol 80/20	5,080 " 1.5 "	-	235°
Guncotton, wet	5,500 " 1.23 "	-	187°
Torpex	6,850 " 1.73 "	-	
T. N. T.	6,900 " 1.57 "	81.1°	240°
Picric acid	7,250 " 1.63 "	121.6°	250°
Guncotton, dry	7,300 " 1.15 "	-	187°
C. E.	7,300 " 1.5 "	129.1°	180°
Nitroglycerine	7,750 " - "	13°	188°
P. E. T. N.	8,100 " 1.7 "	141°	145-150°
R. D. X.	8,400 " 1.7 "	203.5°	213°

The velocity of detonation is not greatly affected by external conditions unless these are extreme. Air temperature has little or no effect. Increase of confinement has a slight effect only, provided that the confinement is sufficient to ensure complete detonation. In very insensitive explosives, however, the propagation of detonation may not be maintained under light confinement.

The chief factor affecting velocity of detonation is the density of the explosive. Up to a maximum limit increase in density means increase in velocity.

e.g., Picric acid density 1.3 gr./c.c. rate 5,980 metres/sec.  
 " 1.5 " " 7,110 " "  
 " 1.63 " " 7,250 " "

This is the limit for picric acid and further increase in density will not affect the rate of detonation. It should also be noted that increase in density produces also a decrease in sensitivity, e.g. T.N.T. crystals are used as an intermediary, while cast T.N.T. is used as a bursting charge.

It has been found that the effect of detonation is most violent in the direction in which the detonating wave is travelling. It follows, therefore, that both in the design and use of detonators this point should be borne in mind. The most effective part of a detonator is the closed end.

46. Effect of an air gap - If an air gap is introduced into a detonating system the detonation wave, in jumping the gap, loses energy, and the amplitude of the wave falls off in proportion to the size of the gap. If the falling off is great enough, the detonation wave may fade out altogether, and even if the gap is so small that the wave passes over, it may have lost so much of its energy that complete detonation of the remainder of the explosive will not occur, and a 'partial' detonation or 'explosion only' will result.

It is therefore very important to avoid air gaps in a detonating system and to maintain the stress supplied by the initial detonation above the necessary critical value, since detonation breaks down when the amplitude of the wave falls below this critical value. Air gaps are unimportant in an explosion, as the flash crosses the gap easily. Slight gaps between the components of initiating systems are unavoidable, and therefore initiating and intermediary fillings should have an ample margin of power.

47. Sensitiveness to blow and friction - The property which all explosives possess of being brought to explosion by blow or friction is known as "sensitiveness" or "sensitivity", the former designation being used in Service literature. This property is of great importance as it indicates the uses to which an explosive may safely be put and it determines the precautions which must be taken during its manufacture, handling and transport. Very sensitive explosives are required for use in percussion caps and detonators, while those which may be used as bursting charges for shell and have therefore to withstand the considerable shock of discharge from a gun must be very insensitive.

48. Initiation - Explosives are started off by "initiators". These are ignited by a direct blow, friction or flame, and are used for starting the action of combustion, explosion and detonation.

For starting combustion or explosion, a flame only is required and such an initiator is termed "igniferous".



Where a detonating wave is required, however, a "disruptive" initiator is necessary. This starts by burning, but quickly builds up to detonation. The detonating wave from a disruptive initiator is seldom powerful enough in itself to set off the comparatively stable high explosive used as the main filling or bursting charge of a shell and consequently an "intermediary" or "exploder" is interposed. (The American term "booster" is synonymous with "exploder").

Disruptive initiators and intermediaries are classed as high explosives.

49. Light - This is objectionable in the case of propellants but is of use in locating shell and bomb bursts, and in tracer compositions, which enable the trajectory of a projectile to be observed thereby assisting ranging, and also for star shell and illuminating compositions. In this application gas pressure is redundant and may even be injurious so that compositions are desirable which give only solid products of combustion. Further, hot gases from burning or explosion are ionised, i.e., possess electrical conductivity, so that tracers and igniferous self-destruction elements on shell are found to prohibit the "arming" of radio proximity fuzes. Ionized gases, however, from shell or bomb bursts give radar echo which is much greater than that from the projectile in flight alone. This effect assists ranging at night or in foggy weather.

50. Sound - All explosions or detonations give rise to sound waves (i.e., longitudinal waves) in the air and consist of successive compressions and rarefactions. Where these are of large amplitude as when a charge of high explosive is detonated, they give rise to blast and suction effects which may do considerable damage to material and personnel. The blast from the muzzle gases of a gun which may at the muzzle attain magnitudes of the order of 4 tons per square inch, can produce harmful physiological effects unless personnel and particularly their ears are adequately protected. This effect may be a great annoyance in "staggered" battery positions where one gun may be firing nearly over another.

Sound waves from ordnance or shell bursts are made use of in sound ranging and the location of hostile batteries.

51. Compatibility - It is clearly of great importance that explosives shall not interact with either (a) other explosives with which they may be in contact or (b) their containers. This criterion is known as compatibility. The assessment of compatibility is not always easy, for small changes in conditions may greatly affect the result. Thus, mercury fulminate is quite stable towards copper at ordinary temperatures when dry, but will decompose when placed in copper caps in the presence of moisture. It is possible to obtain an assessment of compatibility by putting the store concerned on climatic trial.

Incompatibility may lead to dangerous conditions, or to changes in explosive or ballistic performance. Thus, lead azide in copper, in the presence of moisture, may decompose with the formation of a very sensitive copper azide. Nitroglycerine vapour from a propellant is absorbed by celluloid. Thus if a propellant which contains nitroglycerine is filled into celluloid containers (e.g. mortar secondary cartridges) the nitroglycerine migrates from the propellant to the celluloid, and a fall in ballistics results. This also happened in the case of the celluloid cups which were, formerly, used for sealing tracer cavities in the bases of shells. The celluloid cups softened and dropped out. Picric acid, for example, reacts with certain metals, especially lead, to give sensitive salts. Stringent precautions, therefore, have to be taken by specifying "lead freedom" (not more than 0.03 per cent lead) in any store or ingredient which may possibly be used with picric acid or shellite.

Since it is essential, in the British services, that stores should remain safe and efficient for at least 25 years, compatibility must always be borne in mind when considering the design or storage of ammunition. The following are examples of incompatibility:-

- (a) Carbanite softens paint. The interiors of wooden boxes in which bulk cordite is stored are, therefore, left "in the white".
- (b) Nitrous gases from the decomposition of propellants, and ammonia from picrite propellants both cause "season cracking" of cartridge brass. It is necessary, therefore, to protect the interiors of cartridge cases by shellacking before insertion of the propellant charge in the filling factory.
- (c) Ammonium nitrate, especially when damp, is liable to attack metals. The interiors of shell, mortar bombs, etc. therefore, which are to be filled amatol or other ammonium nitrate mixtures, must be protected, before filling, by means of copal varnish.
- (d) T.N.T. is incompatible with alkali.
- (e) Ordinary vulcanised rubber contains sulphur, which readily attacks brass (cartridge brass and primer bodies) to give black copper sulphide, CuS.
- (f) P.E.T.N. is incompatible with amatol.
- (g) Tetryl (C.E.) is incompatible with gunpowder.
- (h) Lead azide is incompatible with copper and with shellac varnish.
- (j) Picric acid is incompatible with bleaching powder.

52. Compositions - In addition to the propellants and high explosives, there is a variety of compositions, chief among them being gunpowder. This is the oldest known explosive, and although no longer used as a propellant or lethal bursting charge, is used extensively and forms vital links in almost every ammunition component. Other compositions include igniferous initiators, illuminants for star shell and tracers and smoke producers.

#### USES

53. A diagrammatic representation of the various types and uses of explosives is at Appendix A.

## Chapter 2 Explosives

### Section 2. Propellants

#### GENERAL

54. These are materials which when ignited in the gun chamber, burn smoothly, exert pressure on the base of the projectile thereby causing it to move up the bore of the gun. The pressure developed depends upon the rate at which the propellant burns. This can be controlled by the selection of the size and shape of the pieces of which the propellant charge is made up, by the composition of the propellant and by the amount used.

These factors have to be considered in relation to the size of the gun chamber, the dimensions of the bore and the weight of the projectile. Thus, when estimating a charge to give a certain muzzle velocity without exceeding a specified pressure, the smallest possible size of propellant is selected, in order to get the following advantages:-

- (a) Greatest possible efficiency, i.e., the smallest possible charge weight, in order to assist loading and packaging.
- (b) Position of "all burnt" as far back as possible.

Propellants are made in various shapes e.g. cord, ribbon, tubular and slotted tubular. They are also made in granular form, in this form they may be tubular or multitubular. (See Fig. 2)

Ideally only one nature of propellant should be used in one equipment, but this is not possible at present.

#### HISTORICAL

55. The origin of propellants and explosives is rather obscure and is bound up with the discovery of methods of purifying saltpetre. The first propellant discovered, in the 13th century, was gunpowder which is a mixture of saltpetre, sulphur and charcoal. Gunpowder was used as a propellant until the late 19th century and the development of modern propellants can be said to date from attempts in 1845 by Schonbein to use nitrocellulose (guncotton) in place of gunpowder. The nitrocellulose was manufactured by the action of nitric acid and sulphuric acid on cotton. In 1884 Vielle produced a propellant using only nitrocellulose, hot rolled into sheets and cut into squares which was called "Poudre B". Nobel produced a similar produce by mixing nitrocellulose and nitroglycerine under water, hot rolling the resultant paste and cutting it into small squares, this was called Ballistite. In 1888 Avel used a mixture of nitrocellulose, nitroglycerine and mineral jelly gelatinized by acetone. This was pressed into cords and dried to remove the acetone used in the process. Being in cord form it was called cordite and was adopted for use by the Services in 1891 in place of gunpowder. Since this date efforts have been concentrated on producing improvements such as the production of more power in a smaller space, the use of stabilisers to increase storage life and the inclusion of ingredients to decrease the smoke, flash and heat produced.

#### BURNING OF A PROPELLANT

56. The main characteristics of the burning of a propellant are:-

- (a) burning is purely on the surface and normal to the surface;
- (b) the rate of burning, increases with pressure on the surface. It is practically proportional to pressure, though it departs from linearity at high pressures.

As the propellant starts to burn, gas is generated and the pressure in the chamber of the gun rises until the projectile starts to move. The pressure at which movement commences is known as "shot start pressure".

After this pressure continues to rise until the increase of volume behind the projectile counter balances the rise of pressure caused by the evolution of gas. At this point we get the point of "maximum pressure", after which the pressure falls off slowly until all the propellant has been consumed. The pressure will then fall more rapidly because of the expansion and heat losses, nevertheless the velocity will continue to increase until the pressure of the gases has ceased to act on the base of the projectile, i.e. shortly after it has left the muzzle of the gun.

The point of maximum pressure is reached very quickly, and the maximum acceleration of the projectile results in very great "set-back" effect on the projectile. This effect is important in the design of shell and fuzes.

57. All burnt position - The position reached in the bore of a gun by the projectile at the moment when all the propellant charge has been consumed is known as the "all burnt" point.

The gun is capable of producing its maximum muzzle velocity when the optimum power is used and this usually means a large size of propellant, large charge weight, a forward position of "all burnt", and higher muzzle pressures. The propellant however, is used most efficiently when "all burnt" is well back, and this is the usual position. If the "all burnt" point is too near the muzzle, irregular ballistics are caused. While if it is outside the muzzle we not only waste propellants, but also increase the risk of burning particles igniting material near the gun.

#### PROPERTIES OF THE IDEAL PROPELLANT

58. Rate of burning - It must be regular and readily controllable, thus in order that the muzzle velocity shall be uniform from projectile to projectile and so enable the gunner to hit a selected target, the rate of burning and the amount of heat and gas produced by a propellant must be as uniform as possible. This is usually attained by using a colloidal (i.e. gelatinized) explosive of a uniform composition which can only burn from the surface, layer to layer. The amount of surface exposed governs the rate at which it can burn e.g. when in cord form the size of cord will determine the rate of burning since, for a given charge weight, a large number of small cords will offer more burning surface than a few large cords. The area of the burning surface can be further increased by changing the shape of the propellant, e.g. ribbon, tubular, slotted tubular and granular. By this method it is possible for a propellant of identical composition but of different shape and size to be used in weapons varying from revolvers to heavy guns. Different burning characteristics can also be obtained by changing the ingredients or the proportions used in the manufacture of the propellant.

59. It must not detonate - Propellants are made from ingredients some or all of which are capable of being detonated. It is essential that there should be no tendency for the resultant propellant to detonate when used under the conditions for which it is introduced.

60. It should be free from flash - This is important from a tactical point of view as muzzle flash will divulge the position of an active gun especially at night. Freedom from backflash is also important as there would be danger to the guns crew and also the risk of igniting cartridges or other inflammable material in the vicinity of the breech.

The cause of muzzle and backflash is the formation of incompletely burnt gases which are at a high temperature. These gases ignite on coming into contact with the outside air after the projectile has left the muzzle or when the breech is opened.

61. It should be smokeless - This is as important as freedom from flash from a tactical point of view. In addition excessive smoke is inconvenient when a gun is being layed on a visual target, the smoke may obscure the view of the gun crew and make observation difficult.

62. It should not leave residue - Hot smouldering fragments of incompletely burnt propellant or charge bags are obviously dangerous if they remain in the chamber or bore of a gun. Solid residue fouls the bore and increases erosion.

63. It should not cause erosion - Erosion of the chamber and the bore of a gun is due to the washing action of the hot gases; it is partly caused by their high velocity but mainly by their high temperature. The rapid heating and cooling to which the bore of a gun is subjected further tends to disintegrate the surface metal. Therefore the propellant should burn as coolly as possible consistent with obtaining the required ballistics.

64. It must not break up - The sticks or granules of propellant, which make up a charge, must not break up during burning as this would cause a change in area of the burning surface and hence irregular ballistics.

65. It should be easy to ignite - Most propellants are not easy to ignite and the use of gunpowder igniters is almost universal. The ignition of the propellant must not be so difficult that the igniter has to be large in size.

66. It should be stable in storage and transport - The explosives used in propellants undergo a continuous process of decomposition. With modern propellants the rate of this decomposition is very slow indeed and the progress of decomposition is determined by the periodical examination of all propellants stored in bulk together with that made up into charges.

Decomposition is accompanied by an evolution of heat and the formation of free acids. If the heat is not dissipated and the free acids are not neutralised decomposition is accelerated and may eventually lead to spontaneous ignition. Cool dry storage and the addition of stabilizers, which neutralise the free acids, are the best means of prolonging the life of the propellant.

67. It should be insensitive to shock and friction - The propellant should be able to be handled and transported with safety both in bulk and when made up into charges.

68. It should be unaffected by moisture and temperature - The general effect of moisture, if absorbed by the propellant, is to alter the density of loading which will cause erratic shooting. In addition damp may cause interaction between the explosive and its surroundings leading to instability.

Exposure, for short periods, to extreme temperatures may lead to physical changes in the propellant which are usually of a temporary nature.

69. It should not be too bulky - The propellant must be powerful so that the required charge and the chamber of the gun do not need to be excessively large.

#### COMPOSITION

70. Particulars of the basic propellants in current use for ammunition are given in Appendix B.

All modern propellants used in the British Service contain nitrocellulose, and when based on this alone, are known as "single-base" types or "nitrocellulose cannon powders". (The American term "cannon powder", which is synonymous with "propellant" is misleading in that these propellants are not powders as normally understood).

British "double-base" type propellants contain nitroglycerine in addition to nitrocellulose and are known as "cordites". The cordites are often further described as "mineral jelly" or "carbamite" according to the stabilizer used.

Picrite propellant or "flashless cordites" as they are sometimes called (e.g. cordite N & NQ) are a "double-base" type of propellant containing in addition to the normal ingredients a high proportion of nitroguanidine (picrite).

The cellulose employed in manufacture may be derived from cotton, wood, grass, or other pulp. This is nitrated and gelatinized. A stabilizer is added to reduce the natural decay of such mixtures, and a flash inhibitor incorporated (with or without a moderant) where flashlessness is required. During manufacture, the propellant in the form of a dough is generally pressed through dies which determine the shape of the cross-section. This dough emerges similar in form to macaroni and is afterwards cut into long "sticks" or very short lengths called "granules".

#### CHARACTERISTICS

71. The temperature of the propellant charge before ignition affects the ballistics obtained. The range tables, which are compiled for the Service projectile at a standard muzzle velocity, include data to show the variation in shooting which may be expected due to variation in charge temperature.

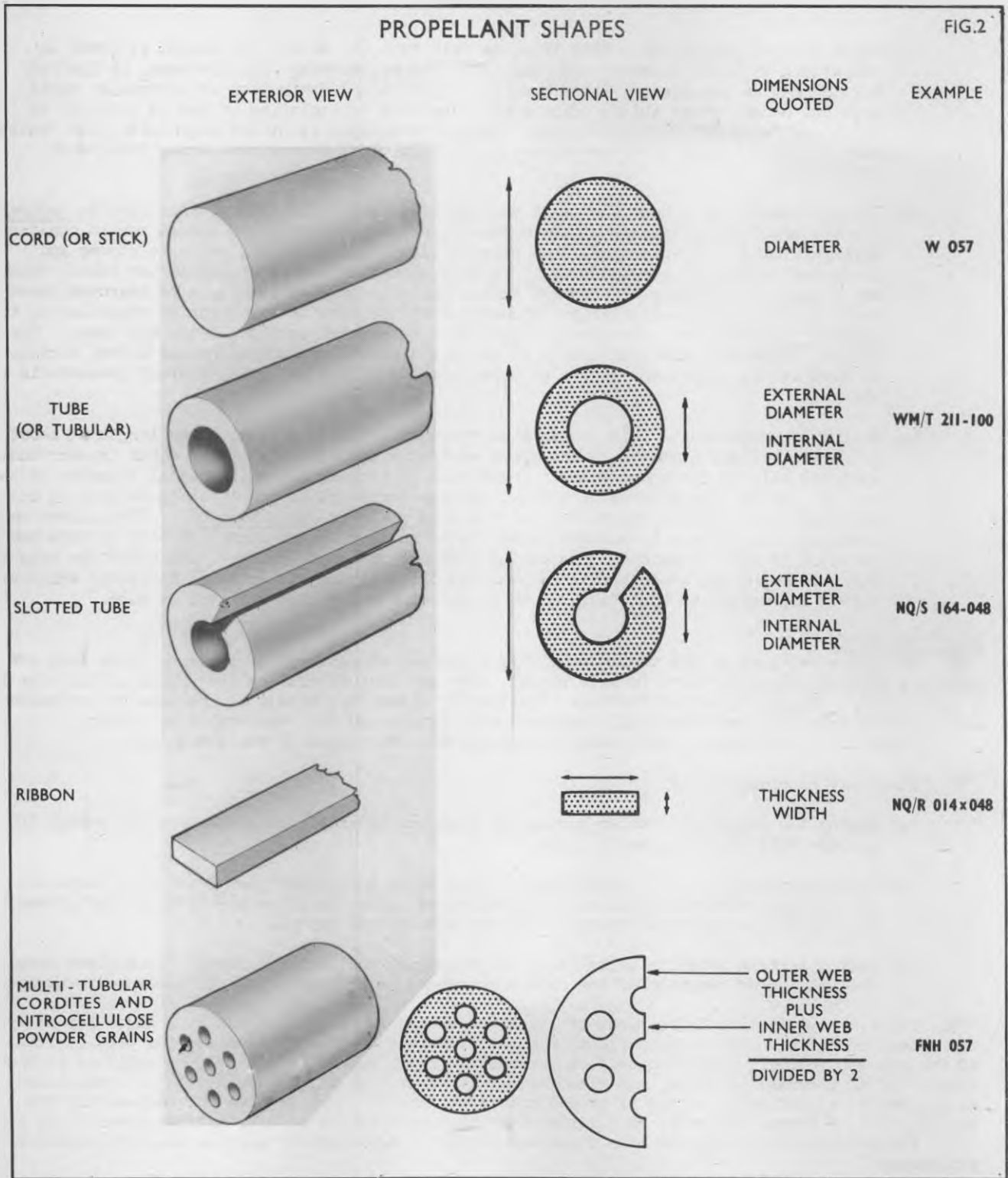
High charge temperatures lead to higher chamber pressures which may be excessive in extreme conditions. Accordingly it is correct drill to keep charges as reasonably cool as possible and particularly to keep ready-use ammunition at as uniform a temperature as possible to ensure consistent shooting.

72. The heat conductivity of propellants is low, with the consequences that charges tend to lag behind their surroundings in regard to change of temperature. This presents some problems in the determination of the effective charge temperature, particularly with Q.F. ammunition and is one of the main reasons why Q.F. ammunition should not be subjected to direct sunlight. Apart from this consideration, direct sunlight may also in extreme cases produce changes of ballistics, although this is unlikely with modern propellants as compared with the older ones. The method of measuring charge temperature is dealt with in training manuals.

73. Lotting - Propellants are produced in "lots" which are checked for homogeneity and performance. Cartridges made up from one lot (as is indicated by the lot or batch marking) should therefore be identical in character and performance in a given gun.

With modern propellants, reasonable age does not materially affect ballistics.

74. Colour - The colour of most propellants varies from a light amber and various shades of blue and green to black. In the case of cordite, the colour deepens with age.



75. Shape and size - The shape and size or form of the propellant determines the rate of burning and provides the necessary control to suit different calibres and barrel lengths as well as varying charges. Generally, the smaller the surface area exposed the slower the rate of burning. The cross sections most commonly used are shown in Fig. 2.

- (a) Stick or cord propellant - With this, as with tube (b) below, the length is great in comparison with the diameter and 'end effect' i.e., burning from the ends, is ignored. Burning may be considered, therefore, as the continued diminution of a circular cross section, hence, other things being equal, the rate of evolution of gas is greatest at first and falls off during burning. Such a propellant is called degressive, and tends to give a rather "peaky" pressure-space curve. In order to overcome this, there were introduced:-
- (b) Tubular propellant - Here the cross section is a ring. In theory, this form is neutral, for the combined perimeters of the external and internal surfaces should remain constant during burning. In practice, this form is slightly degressive, owing to slower and irregular burning of the interior. Further, pressure builds up inside the tubes, which may burst, particularly if they are initially in a state of stress. To overcome these defects, which are particularly noticeable with the more brittle picrite propellants, the slotted tube form was introduced. This is a tube which is slit all the way down. The sticks, therefore, are less likely to be in a state of mechanical stress before firing. As soon as the propellant starts to burn it opens up and relieves internal pressure in the sticks.
- (c) Multitube propellant - This consists of short cylindrical grains, whose length is about 2.1/2 times their diameter. The cross section shows a central hole, which is surrounded symmetrically by six equal holes. Each hole is approx. 1/10th the total diameter of the grain. As the grain burns, its total surface increases (seven holes increasing as one external circumference decreases) so that this shape is 'progressive'. For a given maximum pressure, the maximum is reached rather later in shot travel than with cord or tube and the pressure is more sustained, thus giving a higher muzzle velocity. But after the webs have burnt through, the grain breaks up into six internal and six external 'slivers' which are highly degressive so that "all burnt" is rather earlier than for cord or tube.

#### FLASH AND SMOKE

76. The gases released at the muzzle on firing a gun may cause flash or smoke. Since they are released with considerable force (muzzle blast), they may disturb dust on the ground giving rise to a dust cloud. Smoke, flash and dust are undesirable, since they result in the loss of concealment and, particularly in direct shooting, interfere with laying and the observation of tracer.

Flash is the ignition of hot gases in contact with the oxygen of the atmosphere.

77. Flash may be prevented by:-

- (a) Making the propellant cooler burning so that the liberated gases are not hot enough to combine with the atmospheric oxygen.
- (b) Including picrite in the propellant. When burnt this substance gives off a large amount of nitrogen which dilutes the concentration of carbon monoxide and hydrogen and prevents its forming an ignitable mixture with the atmospheric oxygen.
- (c) Adding certain metallic salts (e.g. of potassium) to the propellant. This slows down the process of reaction of the carbon monoxide and hydrogen with the atmospheric oxygen.

78. The equally undesirable features of flash and smoke, although governed to a major extent by the actual composition of the propellant, are also affected by the ignition and the peculiarities of the gun and charge. Unfortunately, a decrease in flash can sometimes only be achieved at the expense of an increase in smoke, and vice versa. In fact, the term "flashless" (or "smokeless") as applied to a particular nature of propellant expresses the intention but not necessarily the result, i.e., a charge described as flashless may in some guns and some conditions give a full flash.

The products of combustion of a flashless charge contain carbon monoxide and are therefore poisonous.

79. Although considerable progress has been made, cartridges have not yet been produced which are both smokeless and flashless. The problem is greatest with the high performance guns, i.e., those giving a high MV and working at a high chamber pressure.

The present policy is:-

- (a) For indirect fire weapons (Field Branch and H.A.A. in the ground role) flash is not acceptable because of enemy flash spotting at night. Smoke is therefore accepted as the lesser evil.
- (b) For direct fire weapons i.e. anti-tank, etc., smoke is unacceptable for reasons of loss of concealment and interference with laying and the observation of tracer. Flash is accepted as the lesser evil, although every attempt is being made to reduce it.

PROPERTIES OF THE COMMONER PROPELLANTS

80. The chief characteristics and points of difference of the main types of propellants are shown in the following table:-

Type	Modern double-base (flashing) cordites e.g.		Picrite (flashless) propellants e.g.	Early single-base propellant e.g.	Modern single-base (flashless) propellant e.g.	
Propellant	W, WM	SC, HSC	N, NQ	NCT	NH	FNH
Form	Completely colloidal or gelatinous. Used in "sticks" and bundled.		Not entirely colloidal and slightly brittle. Used in very short lengths or "grains". Filled loose. (N, may also be used in sticks).			
Ignition	Fairly easy with moderate quantity of gunpowder.		Difficult. Requires more gunpowder than W or WM.	Fairly difficult.		Difficult.
Smoke	Little		Considerable, but partly due to more powder for ignition.	Moderate		Considerable, but partly due to more powder for ignition.
Flash	Considerable, particularly in high pressure guns.		Practically none in many guns, but may be considerable in high pressure guns.	Considerable		Practically none in many guns, but may be considerable in high pressure guns.
Erosion	Moderate	SC moderate HSC considerable.	Little	Moderate	Moderate but less NCT	Little
Power (inverse of bulk)	Good	SC Good HSC Better	Low	Moderate	Moderate but less NCT	Low
Regularity of burning	Good		Should be good	Moderate	Good	
Fouling	Little		Rather bad. Frequent cleaning of mechanisms is desirable.	Fair		Rather bad. Frequent cleaning of mechanism is desirable.
Resistance to ageing	Good			Bad	Good	
Effect of moisture	Slight		Very slight	Bad	Poor	
Effect of heat	Very slight except at extreme high temperature.			Bad	Promotes loss of residual volatile solvent giving change in ballistics. Storage in hermetically sealed containers desirable.	
Effect of cold	Exudation of nitro-glycerine may take place at low temperatures. Not likely normally.		Practically nil	None		

NOMENCLATURE

81. Nature - The nature of the propellant is indicated by a letter or combination of letters, but the significance of a particular letter may vary according to its position in the combination.

The various letters used are shown in the following paragraph. Some of the letters describe propellants not in use with Field Branch Artillery ammunition, but a complete list is given in order to complete the picture and provide for any future developments.

The use of three figure sizing giving dimensions to one-thousandth of an inch or two figure sizing giving dimensions to one-hundredth of an inch is related to the composition and production process of the propellant.

The following are examples of propellant identification code letters combined with shape letters and size figures:-

Cordite				Granular NC Powders
Cord (stick)	Ribbon	Tubular	Slotted Tubular	
AN .048 N .048 NQ .050 SC .048 W .057 WM .017	NQ/R 014 x 048	SC/T 198-100 W/T 206-100 WM/T 211-100	N/S 164-048 NQ/S 164-048	FNH 057 FNHP 038 NH 050

82. Identification code indication nature of propellant - The following code is used in the marking of gun and mortar cartridges.

<u>DESIGNATION OF PROPELLANT</u>	<u>IDENTIFICATION LETTERS, ETC.</u>
(Nitrocellulose powders)	
Nitrocellulose rifle powder Mk. 8Z.	NCRP (8Z)
Neonite No. 9	NRN9
Neonite No. 12	NRN12
NCT powder (U.S. NC(pyro) i.e.1914-18 production)	NCT
NH powder (U.S. Hercules NH)	NH
NH powder (U.S. Dupont NH - later M.6)	NH
FNH Powder (U.S. Dupont FNH - later M.1)	FNH
FNH powder (U.S. Hercules FNH - later M.4)	FNH
FNHP powder (U.S. Dupont production for U.K.)	FNHP
FNHP powder (U.S. Hercules production for U.K.)	FNHP
(Nitrocellulose - nitroglycerine compositions)	
Ballistite B	BAL.B
Cordite	A
Cordite AN	AN
Cordite ASN	ASN
Cordite CD	CD
Cordite HSC	HSC
Cordite HSCK	HSCK
Cordite MC	MC
Cordite MD	MD
Cordite MDC	MDC
Cordite RDB	RDB
Cordite SC	SC
Cordite W	W
Cordite WM	WM
M4X (U.S. Dupont)	M4X
81 mm. mortar powder (U.S. Hercules)	HERC81 mm.
FNHDB (U.S. Hercules FNH - later M.2)	FNHDB
FNHDB (U.S. Hercules FNH - later M.5)	FNHDB
(Nitrocellulose - nitroglycerine - picrite compositions)	
Cordite NF	NF
Cordite N	N
Cordite NQF	NQF
Cordite NQ	NQ
Cordite NP	NP



LINE

(Nitrocellulose - nitroglycerine - picrite compositions)

Cordite NQFP	NQFP
Cordite N2P	N2P
Cordite MNF	MNF
Cordite MNQF	MNQF
Cordite MNF2P	MNF2P

83. American propellants - The British nomenclature and identification letters for U.S. gun propellants are not the same as those now used by the Americans. In amplification of the corresponding U.S. designations given in para. 82 the following is a brief summary of the positions:-

- NCT These letters adopted by us in the 1914-18 war was to indicate "nitrocellulose tubular", have not been used in the U.S. where the propellant was designated "powder propellant nitrocellulose (pyro)" and is now obsolete.
- NH These letters were in use in the U.S. to mean "non-hygroscopic" in the designation of both Hercules and Dupont smokeless cannon powders when we began to import these propellants in 1940. We used the letters in the designation "NH powder" which we adopted for both. Later only the Dupont powder was produced and in time became known in the U.S. as "powder propellant M.6". We have continued to use the designation "NH powder".
- FNH These letters were in use in the U.S. to mean "flashless, non-hygroscopic" in the designation of both Hercules and Dupont flashless cannon powders when we began to import these propellants in 1940. We used the letters in the designation "FNH powder" which we adopted for both. Later, under American nomenclature, the Hercules powder became "powder propellant M.4" and the Dupont, "powder propellant M.1" and the letters FNH were used only as marking to indicate a flashless performance in a given gun irrespective of the composition. In time only the M.1 was produced and this we have continued to call "FNH powder".
- FNHP These letters have not been used in the U.S. nomenclature but were adopted in British nomenclature for Hercules and Dupont flashless cannon powders specially produced to meet a British requirement in 1940. Later only the Dupont powder was produced.
- FNHDB These letters have not been used in the U.S. nomenclature but were introduced in the British designation of the two Hercules double base flashless cannon powders imported during the 1939-45 war. Under American nomenclature these propellants were later designated "powders propellant M.2 and M.5". Neither is used in British ammunition and the letters have remain unchanged.

84. Propellant shape letters and size figures - With certain exceptions, the designation of a propellant includes also the shape and the size dimensions in which the propellant is produced. The exceptions are the propellants which are normally in the finer granular forms and comprise:-

- Nitrocellulose rifle powder Mk. 8Z
- Neonites No. 9 and No. 12
- Ballistite
- M4X
- 81 mm. mortar powder

The shape (i.e. physical form) (Fig. 2) in which the propellant has been produced is normally indicated by the use of a single code letter as a suffix to the identification code given above.

The shape code letter is always preceded by an oblique stroke to separate it from the propellant identification letters. The shape letters used are:-

M	Multi-tubular (multiple perforations) granules
R	Ribbon (strip)
S	Slotted tubular cord
T	Tubular cord
Z	Scroll

No shape letter is used to indicate propellant in cord (stick) form because this is the normal.

Likewise, the suffix letter M is not used in connection with U.S. propellants because "multi-perforated" is the American normal.

The nominal size dimensions corresponding to the shape in which the propellant has been produced follow the shape letter, where used, and are given by the appropriate numerals and signs as follows:-

Cord or stick	Diameter, e.g. 16 or 182
Multi-tubular	Mean thickness of webs between perforations, e.g. 055
Ribbon or strip	Thickness and width of strip separated by multiplication sign, e.g. 014 x 048
Scroll	Thickness of sheet, e.g. 008
Slotted tubular cord	External and internal diameters of tube separated by minus sign, e.g. 206-100
Tubular cord	As for slotted tubular cord.

#### MULTIPLICITY OF PROPELLANTS

85. Multiplicity of propellants in the same equipment is undesirable for the following reasons:-

- (a) Charge temperature corrections differ from propellant to propellant.
- (b) The wear/MV relationships are different, so that charges of different natures of propellant will not match ballistically in the same gun.
- (c) EFC values vary from nature to nature.

These factors all entail unnecessary complications and extra time and trouble for the user, especially at calibration and in predicated shooting.

Owing to limitation of production capacity in the country, multiplicity of propellants is, at the moment, unavoidable.

## Chapter 2 Explosives

### Section 3. High Explosives

#### DEFINITION

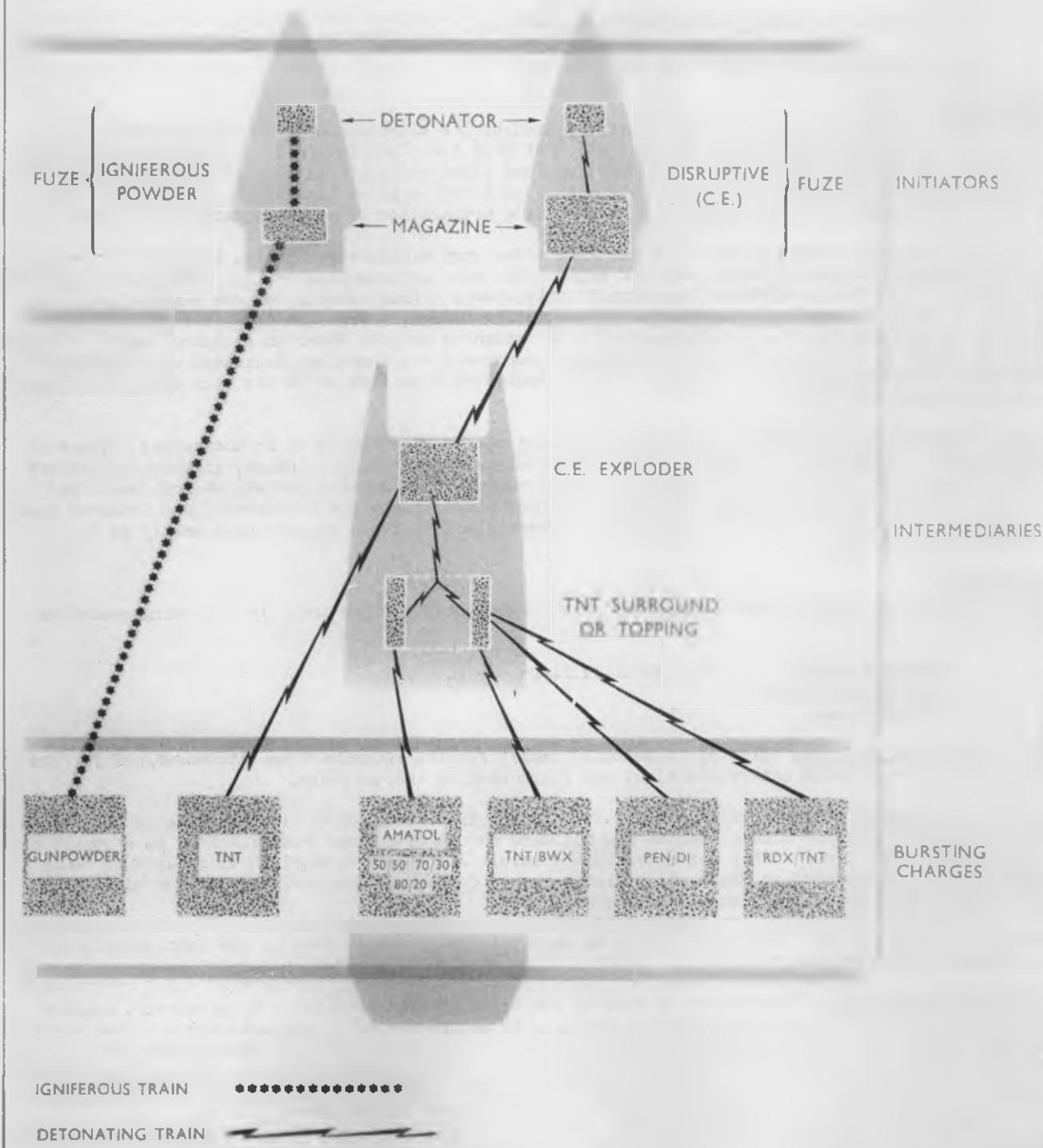
86. A high explosive may be defined as a material which can be detonated and is normally used to give detonation.

87. Properties of the ideal high explosive bursting charge:-

- (a) It should possess power and violence.  
Power is the ability of the explosive to do work and is obviously dependent on the volume of gases formed at the temperature of explosion.  
The time required for the explosive to develop its maximum pressure is not taken into account when determining the power, but is of the very greatest importance where violent blast and disruptive effect are required. The violence of a high explosive will therefore depend very largely on the rate of detonation.
- (b) It should be insensitive to ordinary shocks.  
It has to withstand handling, transport, shock of discharge and, with armour-piercing shell, the shock of impact.  
Sensitiveness to impact and to friction is not always similar in the same explosive, although explosives which are very sensitive to the one are usually sensitive to the other. A rise in temperature of an explosive generally increases its sensitiveness, as does a decrease in its density.

FIG. 3

### USE OF INITIATORS, INTERMEDIARIES & BURSTING CHARGES



- (c) It should be free from a tendency to detonate sympathetically.
- (d) It should be stable in storage.
- (e) It should be unaffected by damp and extremes of temperature.
- (f) It should not form unstable or sensitive compounds with metals.
- (g) It should be easily loaded to a high density.
- (h) It should provide smoke for observation.

#### COMPOSITION

88. The basic high explosives are either obtained by the nitration of glycerine (dynamite and gelignite), cellulose (gun-cotton) or derivation of coal tar (lyddite and T.N.T.) or are compounds of nitrogen with mercury (fulminate of mercury) or lead (lead azide and styphnate) obtained by more complex methods. R.D.X. is formed by the action of nitric acid on hexamethylene tetramine, the process being known as "nitrolysis". P.E.T.N. is a preparation of pentaerythritol tetramine.

89. The power and sensitiveness of these explosives vary within wide limits, and for this reason, various mixtures are employed in order to balance the main requirements of high power, low sensitivity to ordinary shocks and sufficient response to initiation. (For example, at one end of the scale, R.D.X. is too sensitive to be used alone as a bursting charge, whereas at the other end, ammonium nitrate is too insensitive. The one requires a deadening and the other an exciting agent). In the case of bursting charges, the proportion of the components are sometimes indicated as percentage following the nomenclature (e.g. "amatol 80/20" indicated a mixture of 80 per cent ammonium nitrate and 20 per cent T.N.T.).

90. There are also compositions which, though not necessarily explosive in themselves, become so when mixed. Examples of these are potassium chlorate and antimony sulphite, in which the former is the "fuel" and the latter the "agent". Small amounts of aluminium powder, meal powder and sulphur are also used to increase the amount of heat and/or flame for initiators, and powdered glass to increase friction and promote initiation. Beeswax and paraffin wax are used mainly as desensitizing agents.

#### CATEGORIES

91. The high explosives used in gun shell are conveniently divided into the following groups or categories:-

- Bursting charges i.e. H.E. shell fillings
- Initiators (disruptive)
- Intermediates

92. The bursting charge (Fig. 3) is normally chosen for its relative insensitiveness and for its power and violence which determines blast and fragmentation respectively.

93. The initiator (Fig. 3) is chosen for its ability to be brought to its full rate of detonation in a very short space of time either as the ultimate result of contact with flash or as a result of a relatively light blow. When detonated as the result of contact with flash it is said to "burn to detonation", a phenomenon in which, in effect, a part of the H.E. burns with explosive violence so producing a "self detonating" shock for the remainder.

As the H.E. initiators are thus necessarily very sensitive, the amount which can be safely used in a gun projectile are small, and it must be carefully supported. Usually the initiator is carried in a small copper detonator shell.

94. The intermediary (Fig. 3) has to pick up the small impulse from the H.E. initiator, amplify it and pass it on as a detonation impulse adequate to secure the efficient detonation of the burster. As they are necessarily required in somewhat greater quantity than the H.E. initiators, the intermediaries are less sensitive than the initiators. When used between the magazine of a fuze and the burster in the shell, the intermediary is usually called the "exploder" which in fact is a rather misleading term. The American term "booster" is more descriptive.

The H.E. explosive system in a shell, or in any ammunition store must conform to the principle of continuity of detonating train, i.e., once the detonation has been initiated, there must be no gap in the train of H.E. sufficient to result in the dissipation of the detonating impulse.

The "one-way traffic" diagram (Fig. 3) illustrates the use of initiators, intermediaries and bursters. The igniferous initiator and powder bursting charge is included to complete the picture.

The characteristics of the various high explosives met with in Field Branch Artillery ammunition will now be considered individually.

#### BURSTING CHARGES i.e. H.E. SHELL FILLINGS

95. T.N.T. (trinitrotoluene) - This is a pale yellow substance with a melting point somewhat below the boiling point of water. It has a low sensitivity (as have all bursters) and is normally filled into the shell cavity in molten condition and allowed to set.

It is chemically inert and is unaffected by moisture. Modern T.N.T. which is pure is unaffected by ordinary variations in temperature, although extremes of heat can cause an oily and explosive exudation which may get nipped in the threads and thus cause a premature.

It has little or no effect on metals.

T.N.T. may be used alone as a bursting charge and also as an ingredient in a considerable number of mixed high explosives, such as the amatols, R.D.X./T.N.T. and pentolite.

As very little smoke is given off on detonation, either a smoke-pellet may be inserted, or a smoke mixture incorporated in the main filling to assist observation.

96. Ammonium nitrate - As with T.N.T., only the purest is used, as the lower grades contain impurities that affect the stability of the mixture in the case of amatol, should the T.N.T. also be of low grade.

Ammonium nitrate is a white crystalline solid, is very hygroscopic and when wet attacks metals, some of the corrosive products being very sensitive.

It is too insensitive to be used alone.

97. Amatol - The name "amatol" covers a range of mixtures of ammonium nitrate with T.N.T., the percentage composition of the mixture, being shown thus - amatol 80/20. The first figure refers to the percentage of ammonium nitrate in the mixture, the other to the percentage of T.N.T.

This intimate mixture of T.N.T. and ammonium nitrate is more powerful but less violent than T.N.T. Broadly speaking, in the amatols, increase of ammonium nitrate content corresponds to decrease of sensitivity and violence but increase in powder.

Ammonium nitrate being hygroscopic and water soluble, amatols must be kept dry, in which latter condition they are stable and inert.

Because of the hygroscopicity of the nitrate the interior of shells are protected by copal varnish and other metal parts by R.D. cement, in addition to special sealing arrangements.

Amatol is made by stirring the nitrate into molten T.N.T. and this mixture is either poured into the shell as with T.N.T., or forced in by screw action if the mixture is too "stodgy" as it is with 80/20.

Amatol was used as a bursting charge mainly in order to economise with T.N.T., the nitrate being cheap and easy to produce. This type of filling is now obsolescent.

In view of their lower violence, the lethality of amatol shell from the point of view of fragmentation is not as good as that of the same shell filled with T.N.T.

98. PEN/D.1 - This consists of pentolite desensitized by the incorporation of wax, usually to about nine per cent of the weight of the mixture. This desensitized pentolite is used as a main filling in small calibre shell only.

99. R.D.X. - This is a white crystalline solid and another very powerful and very violent high explosive of too great a sensitivity to be used alone as a burster. Mixed with 40 to 50 per cent T.N.T., the mixture is suitable for use as a burster in shell, as also are some mixtures of R.D.X. and beeswax. R.D.X. is not affected by moisture or temperature variations and has no effect on metals.

#### CONSTITUENTS

100. The constituents and their percentages used in the principal bursting charges are given in Appendix D.

#### CODE FOR HIGH EXPLOSIVE FILLINGS

101. Details of the abbreviated code letters and numbers stencilled on the shoulder or body of projectiles to denote the particular nature of H.E. filling are given in Appendix D.

#### INITIATORS (DISRUPTIVE)

102. Fulminate of mercury - This consists of small grey or brownish-grey crystals resembling fine sand. It is very sensitive to shock, flame and friction. When ignited it burns to detonation very quickly. It tends to become rather less sensitive when compressed and in this condition it is said to be "dead pressed".

Warm damp storage has a harmful effect on fulminate, decomposing it and causing interaction with the metallic envelope. Hot dry storage also renders fulminate unserviceable, especially when in the small quantities, four to six grains, used in fuzes. Consequently, fuzes fitted with fulminate detonators must be protected from heat as much as possible, particularly from direct sunlight.

It is rarely used alone, its commonest application being as a sensitizer in igniferous initiating mixtures.

103. Lead azide - In appearance it is in the form of very small crystals, like fine white sand. It tends to become greyish brown on exposure to light owing to slight decomposition. It is not as sensitive to blows as fulminate but somewhat more sensitive to friction.

Owing to changes in the crystals which take place when the substance is wet and which render it progressively more sensitive, lead azide must be kept dry, and warm damp storage avoided.

It is widely used in disruptive detonators, and if required to be initiated by a blow, such detonators are frequently sensitized by a layer of sensitive igniferous initiator.

104. Lead styphnate - This is a light yellowish brown crystalline powder. It is rather less sensitive to friction and impact than fulminate but burns rapidly to detonation and is unaffected by moisture or temperature. It is not used alone.

105. A.S.A. - This is a mixture of lead azide, lead styphnate and a small proportion of aluminium powder. It is bright orange in colour and is very sensitive both to flash and to blows. It is stable in dry storage.

It is employed widely in disruptive detonators and does not require sensitization as does lead azide. It is used in the lower disruptive detonator in graze action percussion fuzes under an igniferous detonator.

106. AZY - This is a composite filling used in detonators of fuzes and consists of increments of initiating "A" mixture, lead azide and composition exploding (CE) in varying proportions pressed in layers one above the other.

107. ZY - This is a composite filling used in detonators of fuzes and consists of increments of lead azide and composition exploding (CE) in varying proportions pressed one on top of the other.

108. AZ - This is also a composite filling used in detonators of fuzes and consists of increments of initiating 'A' mixture and lead azide in stated proportions pressed one on top of the other.

#### CONSTITUENTS

109. The constituents and their percentages used in the principal disruptive initiators are given in Appendix C.

#### INTERMEDIATES

110. C.E. (composition exploding) or tetryl - This is a pale yellow crystalline powder which is stable under ordinary conditions of temperature and moisture.

It is a powerful and violent high explosive of intermediate sensitivity, such that it can be caused to detonate correctly by the detonation in contact with it of an acceptably small quantity of disruptive initiator.

It is widely used as a filling in fuze magazines and in small quantities to complete the detonating train between successive parts of a high explosive train. In powder or in pressed form it is also used as the "exploder" in H.E. shell.

With effect from August, 1956, to facilitate production and improve processing, approval was accorded for the use of 0.5% zinc stearate and 0.25% graphite as additives to C.E. pellets for shell exploders and fuzed magazines, and with effect from February, 1957, composition RD.1212A was approved as an alternative to shellac or copal varnish for coating such pellets.

111. R.D.X./beeswax - R.D.X. is an extremely powerful and violent high explosive of sensitivity rather greater than C.E. When mixed with beeswax its sensitivity is greatly reduced and, in this form it can be formed into pellets. Such pellets are used in the exploder system of some H.E. shell, but owing to their low sensitivity they must be used to follow a reasonable quantity of intermediary of greater sensitivity, such as C.E.

The advantage of using R.D.X./BW as an intermediate lies in the fact that it builds up to its full rate of detonation very quickly so that the burster in the shell is thoroughly initiated at its upper end as well as lower in the shell cavity.

112. P.E.T.N. or penthrite - This is a colourless crystalline solid and is an extremely violent and powerful explosive. It is too sensitive to be used alone as a burster, although this difficulty can be overcome by admixture with T.N.T. etc. It is unaffected by heat and moisture and has a stability approaching that of C.E. Its stability, however, is lowered by exposure to strong sunlight.

113. Pentolite - This is a mixture of T.N.T. with P.E.T.N., forming a pale yellow crystalline mass. The T.N.T. serves to desensitize the P.E.T.N. Various mixtures are used, but the commonest contains 50 per cent by weight of each ingredient and is known as pentolite 50/50 and is used as an alternative to C.E. in the magazine of fuzes, and as a burster for small calibre H.E. shell.

114. T.N.T. (trinitrotoluene) - As an intermediary, T.N.T. in crystalline flake form (T.N.T. grade 1 exploder flake) can be used either loose or in the form of prepressed pellets.

It is more sensitive than cast T.N.T., but less so than C.E., and often an exploder system will, for this reason, have a T.N.T. intermediary at the lower end of the shell cavity only. Owing to their susceptibility to T.N.T. exudation from the shell filling, however, the use of T.N.T. crystals is gradually giving place to C.E.

T.N.T. is also sometimes used in the form of a cast tube surrounding the exploder cavity when the burster is amatol for example. This "T.N.T. surround", as it is called, is used for a number of reasons, but when used with amatol it can also be regarded as part of the intermediary system since T.N.T. is more sensitive and more violent than amatol and can thus be regarded as helping the exploder system to secure correct detonation of the amatol.

#### CONSTITUENTS

115. The constituents and percentages used in the principal intermediaries are given in Appendix C.

## Chapter 2 Explosives

### Section 4. Miscellaneous Compositions

#### GENERAL

116. This group of explosives broadly speaking includes the mixtures which burn, but are not employed as propellants and which, under normal conditions of use, do not undergo detonation.

These compositions used in ammunition will be considered individually.

117. Gunpowder - This is easily ignited and for this reason is often used to ignite other explosives. It is, however, extremely vulnerable to moisture and produces large quantities of smoke. In the service it is used in:-

- Igniters for cartridges
- Magazines of tubes, primers and igniferous fuzes
- Blank charges
- Delay compositions
- Time rings in combustion time fuzes
- Bursters (expelling charges) in certain projectiles, e.g. base ejection projectiles.

It consists of a mixture of potassium nitrate, charcoal and sulphur in the proportions of 75.5 per cent, 14.5 per cent and 10 per cent, respectively. These ingredients are ground, mixed in the wet condition, dried and granulated. The granular material resulting is sieved to give products of regular grain sizes.

Gunpowder is very sensitive to flash and when ignited burns with great rapidity. It is sensitive to moisture (since potassium nitrate is water soluble) and if allowed to become damp, cakes on subsequent drying.

Sulphurless gunpowder is a mixture of 70.5 per cent of potassium nitrate and 29.5 per cent of charcoal. It is employed as a priming.

The rate of burning of gunpowder depends upon its grain size and is faster the smaller the grain.

118. Fuze powder - general - Fuze powders as a whole are very sensitive to moisture, which in quite small quantities alters their rate of burning very considerably.

(a) 22 sec. and 30 sec. powders - These consist of 75 per cent potassium nitrate, 16 per cent charcoal and nine per cent sulphur. They are made with specially selected charcoal and under very carefully controlled conditions so as to produce powders which burn regularly and at the desired speed.

FLARE PRODUCING SUBSTANCES

127. These are similar to the smoke compositions, except that instead of producing smoke, the composition on burning produces a flame. Various agents are used and salts or dyes are incorporated to give a distinctive colour to the flame. Common colours are yellow, green and red.

The projectiles are similar in design, filling, fuzeing and functioning to solid composition charged smoke projectiles. Whereas smoke filled projectiles are used mainly in daylight, colour flare projectiles are used mainly at night or under conditions which are adverse to the observation of coloured smoke burst.

CONCLUSION

128. This brief survey of the characteristics of explosives should make clear the extent to which they are affected by temperature, moisture, and directly or indirectly, by the metals with which they are in contact. The metals themselves are also adversely affected by moisture, the rusting of steel and the corrosion of aluminium components can be serious if they are not adequately protected.

As gunpowder is used in almost every component, the first thing to do is to keep ammunition dry, and as propellants, detonators and caps, as well as metals, are adversely affected by heat, ammunition must be kept cool and on no account exposed to direct sunshine for any time.

It must be emphasized that the atmosphere always contains some moisture and it is from this insidious moisture that ammunition must be protected, although, of course, the more obvious forms of water such as rain, dew or condensation will soon render gunpowder useless.

To sum up, therefore, ammunition must be kept:

DRY  
COOL AND  
AWAY FROM DIRECT SUNSHINE



## Chapter 3 Cartridges

### Section 1. Introduction

#### CLASSIFICATION AND COMPARISON

129. Cartridges may be classified as Q.F. or B.L.

130. Q.F. cartridges - The propellant charge is contained in a cartridge case, usually made of brass (although steel cases can also be used) and carrying the means of ignition. Obturation is effected by the cartridge case, which expands against the walls of the chamber on firing. Ignition is achieved by means of a percussion primer screwed into the base of the case.

Q.F. cartridges are divided into two sub-groups:-

- (a) Fixed rounds - where the cartridge and projectile are secured together and loaded as one unit.
- (b) Separate loading ammunition - where the cartridge and projectile are loaded separately.

In Field Branch Artillery only one system is in use, i.e., separate Q.F.

131. B.L. cartridges - The propellant charge is contained in a fabric (usually silk-cloth) bag, to which is attached an igniter containing gunpowder, this being normally sewn on to one or both ends. Obturation is provided by the breech mechanism. Cartridges of this type are normally ignited by means of an electric or percussion tube inserted in the rear end of the vent of the breech mechanism. The flash from the tube ignites the gunpowder in the igniter, which in turn ignites the propellant in the cartridge bag. In Field Branch Artillery percussion tubes only are used.

The projectile and cartridge are loaded separately.

#### COMPARISONS OF Q.F. (Separate loading) and B.L. CARTRIDGE SYSTEM

132. The following gives briefly the advantages and disadvantages:-

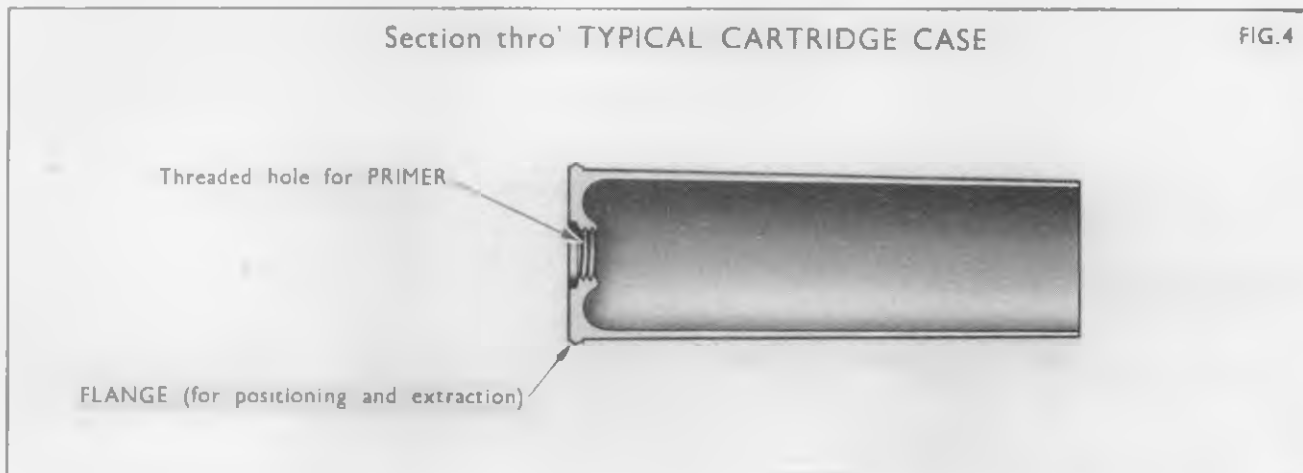
<u>Q.F. CARTRIDGE</u>	<u>B.L. CARTRIDGE</u>
The charge is better protected from flash, spray and moisture.	It is light in weight.
Quicker loading, no sponging out and no tube to insert.	It is cheaper and easier to manufacture.
No risk of premature firing owing to smouldering debris from previous rounds.	No litter of empty cases after firing.
	In the case of a misfire the tube can be changed without opening the breech.
	More care required, under adverse weather conditions, to ensure igniter is kept dry.

In general it may be said that the advantage of the Q.F. system decreases as weight and size of ammunition increase. But where bursts of very rapid fire may be required, Q.F. ammunition is essential.

#### THE CARTRIDGE CASE (Fig. 4)

133. Cartridge cases follow a common design in the British Service. The brass types are in one piece, solid drawn from a flat metal disc by a series of drawing and annealing operations. British steel cases are generally built up, the main components being the base and body.

The base of the cartridge case is enlarged to form a flange to position the case in loading and to provide a means of extraction after firing; it is bored centrally and usually threaded to take the primer. The body is tapered slightly to facilitate loading and extraction whilst the mouth is reduced in thickness to assist expansion and prevent gas escape when the propellant is ignited.



Cartridge cases for separate loading may differ somewhat at the mouth according to the method used for the retention and protection of the propellant.

Brass cases occasionally develop cracks spontaneously during prolonged storage. A crack near the base may be the means of putting the gun out of action and the daily check of ready-use cases is therefore most important and necessary. Short cracks near the mouth can be accepted as they cause little harm, but cracks elsewhere in the case should entail rejection. If a cracked case is loaded and fired, the propellant gases surge through the crack and erode the gun so severely that if a good case is subsequently loaded and fired it may collapse at the eroded spot through lack of support.

#### THE CARTRIDGE BAG

134. These are of different shapes and made of different material depending upon the nature and role of the equipment and the weight, type and size of the propellant used in the assembly of the charge.

Silk cloth is the approved material for the bags of B.L. cartridges, although regenerated cellulose rayon cloth class "A" and "B" is also approved as an alternative.

Normal (variable) charges for Q.F. separate loading cartridges are usually filled in cambric bags.

Blank cartridges, both B.L. and Q.F. when consisting of a charge of gunpowder are contained in silk cloth bags.

#### THE PROPELLANT CHARGE (Fig. 5)

135. This may be made up of cords or sticks or it may be in granulated form as grains.

136. When cords or sticks are used they are formed into bundles and tied with sewing silk or cotton, or in the case of heavier and bulkier charges with silk or shalloon braid to facilitate assembly into the cloth bag used for B.L. cartridges or into the brass case of Q.F. fixed ammunition cartridges.

In the case of the 25 pr. (separate loading) cartridges the propellant used for the normal and incremental charges is filled into cambric bags to permit adjustment.

In the case of Q.F. fixed and separate loading ammunition made up of cord or sticks the base of the bundle is usually arranged to fit over and around the magazine of the primer.

137. With granular propellants the charge is filled loose into the cloth bag in the case of B.L. cartridges and into the brass case of Q.F. fixed ammunition cartridges. If there is considerable free space in the brass case of a Q.F. fixed ammunition round, the propellant may be confined to the rear of the case by means of a leatherboard cup shellacked into position and supported by a distance piece (e.g., a cardboard tube) between the cup and the base of the projectile.

Again in the case of the Q.F. 25 pr. (separate loading) normal and incremental charge portions, the propellant is filled into cambric bags.

138. Tin or lead foil may be included as a decoppering agent. This may be in the form of a strip wrapped around the cord or sticks and secured by sewing silk or in the form of sheet which is loosely crumpled and inserted after the charge is filled into the cartridge bag or brass case.

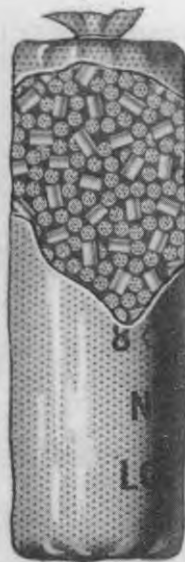
### TYPICAL PROPELLANT CHARGES

FIG. 5

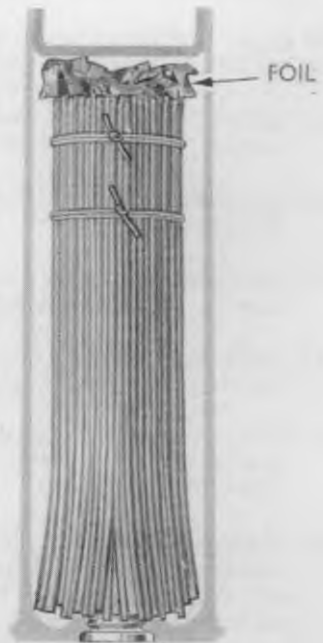
#### For Q. F. (Separate loading) Cartridges



STICK CORDITE  
in CAMBRIC BAG  
for Normal charge portions

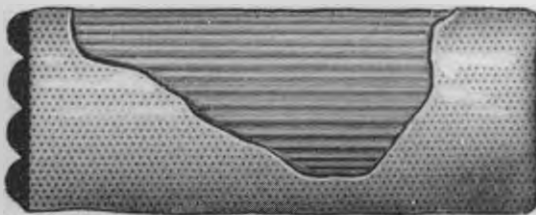


GRANULAR NC  
in CAMBRIC BAG  
for Normal charge portions

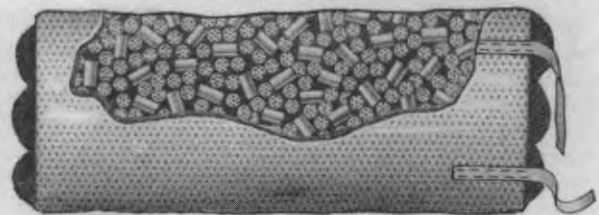


Bundled STICK CORDITE  
in CARTRIDGE CASE  
for Super charge

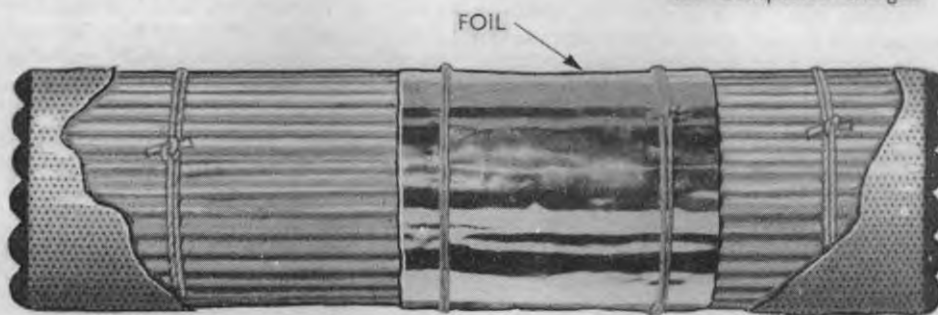
#### For B. L. Cartridges



STICK CORDITE in FABRIC BAG



GRANULAR NC in FABRIC BAG  
for Composite charges



STICK CORDITE in FABRIC BAG  
for Super charge

#### CHARGE-TYPES

139. The following type of charge are used with Field Branch Artillery Equipments:-

- (a) Service - The normal charge. It does not usually give the maximum permissible ballistic performance obtainable with the equipment.
- (b) Super (formerly known as full) - The charge which gives maximum permissible regular ballistics with the service weight of projectile.
- (c) Reduced - A charge which gives lower pressures and hence lower velocities than the normal Service charge. Wear is greatly reduced. The charge is often used for practice.
- (d) Fractional charge - With larger B.L. equipments the Service charge is sub-divided to facilitate transport, handling and loading.
- (e) Incremental charge - With howitzers and certain separate Q.F. gun equipments the charge is made up in increments to permit variation of the ballistic performance.
- (f) Paper shot charge - Used with paper shot to test the mounting or carriage when Service rounds cannot be fired.
- (g) Blank charge - A charge of gunpowder or of small sized propellant sufficiently confined to give a report. Used for saluting and training purposes. It must not be fired with any form of projectile.
- (h) Decoppering charge - Tinfoil or leadfoil is incorporated in the charge, when necessary, to counteract coppering of the bore. Special decoppering charges, containing an extra amount of foil may be used for cleaning a badly coppered gun, although such charges are not a normal Service issue.

140. Portions of cartridge which are removed during the preparation of the charge will be set aside, e.g. in an empty cartridge box for eventual return to the R.A.O.C. for destruction or for use should the cartridges have to be made up to a higher charge. In making up cartridges by replacing portions which have been removed, care must be taken not to mix different natures of propellant in the same cartridge.

#### PROPELLANT PROOF AND CHARGE ADJUSTMENT

141. The object of propellant proof and consequent charge adjustment is to ensure that the ballistics obtained by the user from each charge that he fires are as near constant as possible from round to round and from day to day.

A certain "lot" of propellant is chosen and the ballistics of a given charge weight (known as the nominal charge weight) of it determined accurately; this is known as the "master standard". Other lots of the same propellant are then chosen and tested by firing against this master standard, and are known as "current standards". All other lots of the same propellant are then tested against one of these current standards; as a result an alteration is made to the charge weight of any lot to give the same ballistics as the current standard. This process is called "charge adjustment". It will be realized therefore, that the weight shown in the designation and which is also marked on the cartridge is not necessarily the actual weight of the charge used.

Each nature of propellant has its own master standard.

Ballistic variations between cartridges of different lots of the same nature of propellant that have been so adjusted will be very small unless the lots concerned have undergone widely different storage conditions between the factory and the user. Nature to nature variations may however be large, since any two natures only give the same ballistic performances at a particular temperature and a particular state of wear of a given gun. Since the relationships "wear/MV" and "charge temperature/MV" are different for different natures of propellant, it is evident that mixed natures of propellant will not give good results, and should never be used in practice, (but see para. 150).

Not all charges, however, are adjusted, e.g., 25 pr. charge 1 (W or W.M.). Such unadjusted charges should not be used for unobserved shooting; and lots should not be mixed since, with such charges, large lot to lot variations may occur.

## Chapter 3 Cartridges

### Section 2. Q. F. Cartridges

#### GENERAL

142. Cartridges are used in two ways, forming -

Fixed ammunition.  
Separate loading ammunition

143. With fixed ammunition - The cartridge case is attached to the projectile, by indenting or coning the mouth of the case on to the rear end of the projectile.

144. With separate loading ammunition - The projectile is not attached to the cartridge case.

145. As a general rule, fixed ammunition is used for anti-aircraft and tank and anti-tank guns; separate ammunition being used for howitzers and gun/howitzers.

For Field Branch Artillery howitzers and gun/howitzers, cartridge cases are fitted with a percussion primer screwed centrally into the base; this generally contains a magazine having a sufficient charge of fine grain gunpowder to dispense with the use of an igniter.

Fixed ammunition should not be used in guns or gun/howitzers which are designed to fire separate loading ammunition. In an ordnance which has fired separate ammunition, the chamber is usually worn away at the point where the mouth of the case is situated, and if a fixed round be then fired, the front end of the case will expand into this worn portion and will be liable, therefore, to cause a jam. Secondly, in separate loading ammunition, the projectile must never be inserted in the cartridge case and the two loaded as an entity, as, if this is done, the driving band will not correctly engage in the rifling and, on firing, propellant gases may be forced over and in front of the driving band and cause erratic ranging or even a premature. Thus with separate loading ammunition, the projectile must be correctly rammed home before the cartridge is loaded.

#### SUB-DIVISION OF CARTRIDGES

146. For fixed ammunition, cartridges may be sub-divided into 8 categories i.e., normal, super velocity, super, high velocity, reduced, clearing, paper shot and blank. Such charges cannot be varied, and can only be used for the specific purpose for which they are introduced.

For separate loading guns and gun/howitzers, cartridges are usually sub-divided into normal (which are variable) and super, paper shot and blank which are not variable. Incremental charges for use in conjunction with the variable sections of the normal charge and in certain instances with super charges may also be supplied.

#### DESIGN OF CARTRIDGES

147. Fixed ammunition charges are normally cylindrical in shape.

In nearly all cases the propellant used is cordite in the form of sticks. The sticks are formed into bundles tied with sewing silk and are then inserted in the cartridge case. If granulated powders such as NH or FNH are used these are usually filled loose into the case.

Separate loading ammunition charges, other than the normal charge, are similarly made up, but in such instances the mouth of the case is closed by a leatherboard cup, to prevent the charge being ejected on loading and handling.

148. Q.F. 25 pr. (separate loading) cartridges - Normal charge sections and incremental charges are contained in cambric bags, the material being dyed different colours to facilitate ready identification of the 1st, 2nd and 3rd portions. The mouth of the case is closed by a leatherboard cup which has a lifting becket to facilitate removal for adjustment of the charge.

Super charges are not adjustable, and are consequently inserted (tied with silk sewing but not enclosed in a bag) loose in the cartridge case. For this reason the mouth of the cartridge case is closed by a leatherboard cup which has no lifting becket and which is secured by shellac.

## Chapter 3 Cartridges

### Section 3. Types of Q.F. (Separate loading) Cartridges used in Field Branch Artillery Equipments

#### Q.F. 25 PR. GUN

149. In this instance the term "cartridge" is applied to the brass cartridge case assembled with the percussion primer, propellant charge and retaining cup.

#### NORMAL CHARGES (Fig. 6)

150. The normal charge consists of three portions, each contained in a coloured cambric bag:-

1st portion (red bag)	1st charge	)	
2nd portion (white bag)		)	2nd charge
3rd portion (blue bag)		)	3rd charge

The complete charge is usually composite, i.e., made up with two sizes of propellant which may be of different natures. The propellant may be either cordite or NC powder:-

#### (a) Cordite charges (typical)

The smaller diameter cordite, in sticks of two lengths, is used in the 1st (red) portion, the longer sticks being tied round the shorter ones to form a recess to accommodate the primer. Alternatively sticks of one length may be used to form a ring-shaped charge similar to that for NC powders.

The larger diameter cordite is filled loose into the 2nd (white) and 3rd (blue) bags. Foil, when used, is placed in the blue bag which is also fitted with a lifting becket.

#### (b) NC charges

The smaller size grains are used in the 1st (red) portion which is shaped in the form of a ring either by pulling the mouth of the bag over the closed end and sewing together with silk, or by closing the mouth by sewing and stitching it to the other end of the charge. To facilitate assembly, the ends, will, in future, be left free.

The larger size grains are filled into the 2nd (white) and 3rd (blue) bags, foil, when used, being placed in the latter.

Charges were formerly held in the case by two paper strips diametrically opposed, secured to the case with shellac, the ends being turned over and shellacked together. In current production, security of the charges is achieved by the use of tightly fitting closing cups.

#### (c) NQ charges

Two types have been approved. The earlier type made up as described in (a) above and a latter type where all three portions, although filled to different weights, are assembled with the propellant cut to the same length (see Fig. 6).

151. The mouth of the case is closed by a leatherboard cup (two cups were used in some early production cartridges) which has a lifting becket to facilitate removal for adjustment of the charge.

#### SUPER CHARGES (Fig. 6)

152. The super charge may be filled to different charge types, each type consisting of a bundle of cordite sticks of one size only, tied with sewing silk but not enclosed in a bag. Charges of early manufacture contained sticks of two lengths, the longer sticks being tied around the shorter ones to form a recess for the primer.

Tin or lead foil, loosely crumpled, is placed on top of the charge or wrapped around the charge.

Super charges are not adjustable. For this reason the mouth of the cartridge case is closed by a leatherboard cup which has no lifting becket and is secured with shellac.

NOTE:- For firing the 20 lb. A.P. shot the weight of the super charge is increased by a super charge increment which is placed in the mouth of the cartridge closing cup.

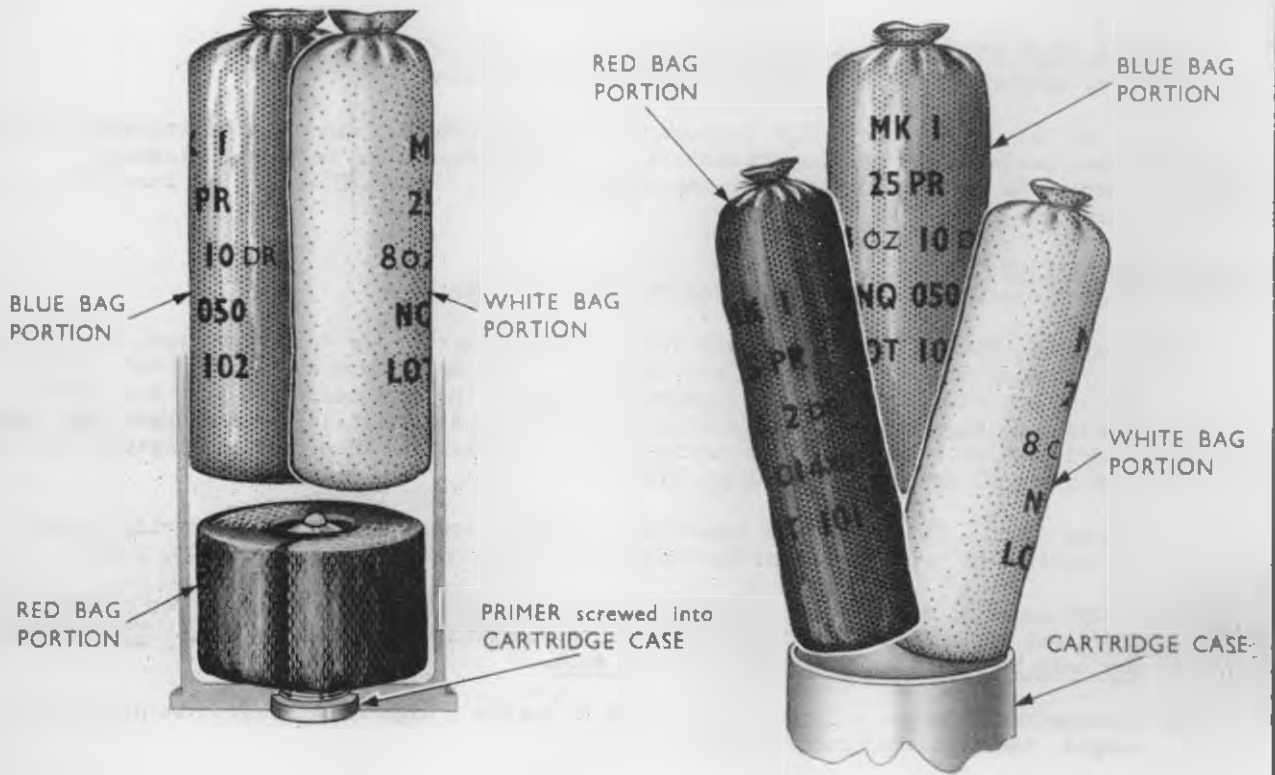
153. All normal and super charges are based on method of filling design DD(L)11242 but there are a number of marks of cartridge within the M. of F. and the arrangement of propellant (and sometimes components) may vary considerably within each mark. Variations in arrangement are known as charge types and are detailed in Appendix E. Part 1. para. 3 and Section 2 Table 2 R. A. O.S. Volume 4 - Ammunition, Pamphlet No. 7 Part 2.

TYPICAL EXAMPLES - SEPARATE LOADING CARTRIDGES - QF. 25PR.

FIG. A

NORMAL (VARIABLE) CHARGES

BAGS FILLED CORDITE OR GRANULATED NC POWDER



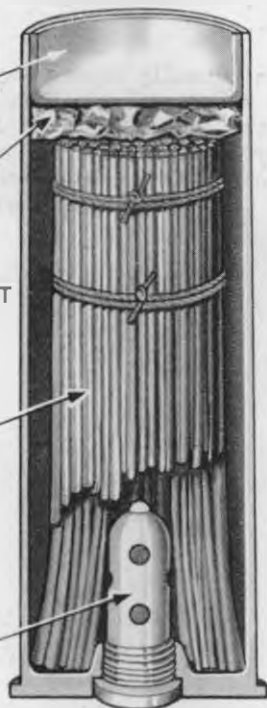
SUPER CHARGE

LEATHERBOARD CLOSING CUP

FOIL (Lead or Tin) DECOPPERING AGENT

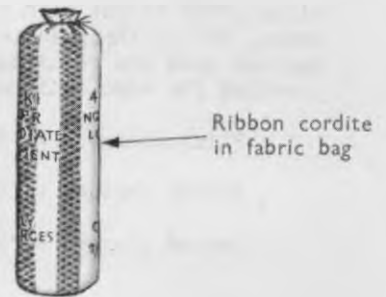
PROPELLANT (Cord Cordite)

PRIMER screwed into CARTRIDGE CASE



INCREMENT CHARGES

For NORMAL (VARIABLE) CHARGES



For SUPER CHARGE



INCREMENT CHARGES (Fig. 6)

154. Intermediate charge increment - The charge, which is contained in a white cylindrical cambric bag, choked at the mouth with sewing silk and marked axially with red stripes 5/8 inch wide at 5/8 inch intervals, is for use with charge 1 or 2 only.

155. Super charge increment - This charge was introduced to supplement the super charge when firing 20 lb. A.P. shot and may not be used with any other projectile. Two types have been introduced viz.

5.1/2 oz. NQ/S 134-040 in celluloid container

4.1/2 oz. chopped (0.25 inch) WM 061 in celluloid container.

Only a few lots of 5.1/2 oz. NQ/S increment have been produced, since the brittleness of the propellant makes satisfactory cutting impossible. For this reason and because a flashing propellant such as WM is more suitable for the anti-tank role, the 4.1/2 oz. WM 061 increment has taken its place.

ISSUE AND PREPARATION

156. The charges are issued and prepared for firing as follows:-

- (a) Charges 1, 2 and 3 - These charges are issued together in the cartridge case, the complete unit forming charge 3. To prepare charge 2, the blue portion must be removed, leaving the red and white portions. To prepare charge 1, the blue and white portions must be removed, leaving the red portion only. The portions of cartridges which have been removed cannot be used to make up other charges i.e. the white and blue portions together will not make charge 2 nor will the red and blue.
- (b) Charge super - This charge is issued as a separate complete unit in a cartridge case. It requires no preparation neither can it be broken down to form charges 1, 2 or 3.
- (c) Charge super plus increment - This charge is made by the addition of a super charge increment which is placed in the mouth of the cartridge case closing cup. This charge may only be used when firing 20 lb. A.P. shot.
- (d) Intermediate charges - These are provided to enable a high trajectory to be used at all ranges, the high trajectory being required:-
  - (i) To clear crests.
  - (ii) To give a large variety of angles of arrival, and hence angles of impact, so that the best use may be made of shell and fuzes.

In mountainous country the number of charges normally issued may not be sufficient to enable all the ground within the range of the gun to be covered. It may be impossible to hit a given target with a certain charge because the shell cannot be dropped in behind the crest, due to the shape of the trajectory given by that charge; the next lower charge may not have the required range to reach the target. Intermediate charges are, therefore, provided for some equipments; in the case of the Q.F. 25 pr. gun they are:-

First charge + 1 intermediate increment

Second charge + 1 intermediate increment

Second charge + -2 intermediate increments



## Chapter 3 Cartridges

### Section 4. B. L. Cartridges

#### GENERAL

157. B.L. cartridges are normally of cylindrical shape.

In nearly all cases the propellant used is cordite in the form of sticks. The sticks are formed into bundles tied with sewing silk, or, in the case of heavier cartridges, with silk braid, in order to secure rigidity of shape and facilitate insertion into the bag, and subsequent loading into the chamber of the ordnance. In those cartridges filled with granulated powders such as N, NH or FNH, the propellant is filled loose.

The charge is inserted into a bag. The open end is then closed by the igniter being sewn on to it. Where two igniters are used the second igniter is sewn to the bottom end of the bag before insertion of the charge.

Lifting beackets of braid are fitted to the larger cartridges to assist handling operations.

#### SUB-DIVISION OF CARTRIDGES

158. For howitzers and gun howitzers, cartridges are necessarily sub-divided into part charges, viz., 1st (lowest), 2nd, 3rd, etc.

For guns, sub-division is only resorted to for two purposes:-

- (a) Excessive weight and size of the full charge in the larger natures.
- (b) The use of a full and reduced charge in one gun, as, for example, when half or two-thirds charges may be required for practice or other purposes, and it is found most convenient to make the full charge up from two separate charges in the required proportion. These are tied firmly together with the ends butted by means of fairleads and lashings.

#### MATERIALS

159. The requisite qualities of material for cloth cartridge bags are:-

- (a) It must be strong enough to withstand the wear and tear of transport and handling.
- (b) It should not deteriorate in store or be affected by the chemicals in the propellant.
- (c) It must be entirely consumed when the gun is fired and must leave no smouldering particles or other residue.  
Accidents have occurred from this cause, generally when using blank cartridges or reduced charges, for which special precautions are laid down and should be carefully adhered to (see para. 311).

160. The material for igniters (see paras. 185 to 189) must, in addition to possessing the above qualities -

- (a) be so close in texture that the gunpowder cannot come out
- (b) be permeable to the flash from the tube.

Generally speaking, silk cloth fulfils the conditions for cartridge bags and shalloon for igniters.

In the past, cream serge, shalloon and cloth mixtures "A", "B" and "Z" have been used as alternatives to silk-cloth but the use of these, except in an emergency, is no longer permitted. Regenerated cellulose rayon cloth class "A" and "B" is, however, approved as an alternative to silk cloth.

#### DIAMETER AND LENGTH

161. Diameter - The cartridge should be large enough to ensure that some part of the gunpowder in the igniter will encounter the flash from the tube.

162. Length - The cartridge should be long enough to ensure that, under all conditions, the igniter will be close to the mushroom head of the breech mechanism or at least the distance between the tube and igniter is not excessive.

In order to obtain the best possible regularity in ballistics, it is essential that the length of the cartridge should, if possible, approximate to the full length of the chamber.

DESIGN OF B.L. HOWITZER AND GUN/HOWITZER CARTRIDGES

163. Considerations governing design - Cartridges for B.L. howitzers and gun/howitzers are made up of the same materials, but in a manner entirely different from that employed for B.L. gun cartridges, for the following reasons:-

- (a) The ordnance is intended for high-angle fire, hence the charge is much lighter compared with that of a gun of the same calibre.
- (b) It is a comparatively short piece of ordnance, therefore the charge must be quick-burning (small size of cord or tubular cordite) so that the whole of the charge may be consumed before the projectile leaves the muzzle.
- (c) With such equipments, large angles of descent may be required at short as well as long ranges. These are obtained by altering the weight of the charge; therefore, a cartridge for a howitzer is made up in sections in such a manner that its weight can be readily reduced.

164. Principles of design - The main principles in design are:-

- (a) The lowest charge must be stable, i.e., does not tend to fall over or lose its shape when loaded alone and so cause a misfire or delay in complete ignition.
- (b) The igniter, which is always fitted over the base of the lowest charge, is made of the largest possible diameter; this is to ensure not only that the flash impinges directly on to the gunpowder but also that the igniter as nearly as possible covers the whole of the cartridge and causes good and regular ignition of the charge.  
For this reason the diameter of the rear end of the charge is not less than the maximum diameter of the complete cartridge, whenever possible.  
In most of the cartridges a mushroom-shaped lowest charge is therefore used.  
A number of cartridges have also been introduced in which, while the mushroom-shaped core is retained, the auxiliary or incremental sections are formed not as rings as formerly, but as flat segments which are pliable enough to be fitted and secured around the stalk.  
In other designs the 1st charge and incremental sections are formed cylindrical, the portions being butted together and secured by webbing ties.

165. The substitution of segments for rings - Is rendered necessary by reason of the larger sizes of propellant used in the cartridges, as it is a matter of some difficulty to bend bundles containing these larger sizes of propellant into a formation of rings. It is also desirable because in the segments the lengths of the sticks are arranged parallel to the core, the interstices forming a number of parallel passages proceeding from the igniter; the whole surface of the charge is, therefore, in the most favourable position to receive the initiating flash.

With the introduction of high-velocity howitzers and gun/howitzers with long but narrow chambers, a very long stalk is employed which is much longer than is necessary for the stability of the lowest charge used. The reason for this is, that it has been found that the firing of a small charge, seated at the end of a long chamber, is liable to cause excessive pressures due to "wave action", so with guns and howitzers having long chambers, where small charges are used, the charge is arranged to stretch the whole length of the chamber, or as nearly so as possible.

The long stalk is very convenient for accommodating the desired number of auxiliary or incremental sections, which can be conveniently arranged around it in one or more tiers.

ARRANGEMENT OF HOWITZER AND GUN/HOWITZER CARTRIDGES

166. Each section of the cartridge is marked with a number to be used when the different charges are being prepared for firing.

The core or main section, which carries the igniter, is always marked No. 1 (or one): the auxiliary sections, Nos. 2, 3, 4 (or two, three, four) and so on.

Different charges are obtained by removing one or more of the auxiliary sections. Thus, in the case of a cartridge comprising a core (No. 1 section) and three subsidiary sections (Nos. 2, 3 and 4 sections), the charges made up from this are:-

Fourth charge	Nos. 1, 2, 3 and 4 sections
Third charge	Nos. 1, 2 and 3 sections
Second charge	Nos. 1 and 2 sections
First charge	No. 1 section.

The weights of the sections are selected in such a manner as to provide for all ranges. Charges made up from other combinations are therefore unnecessary.

Adequate overlap in the range is provided between consecutive charges. This suggests that, at the point of overlap, the lowest charge should, where possible, be selected, in order to conserve the life of the howitzer; it also has the advantage of giving a larger angle of descent.

In certain equipments the "full" charge cartridge is filled and issued as a complete cylindrical cartridge i.e. it is not adjustable.

## Chapter 3 Cartridges

### Section 5. Types used in Field Branch Artillery Equipments

**B.L. 4.5 INCH GUN (Fig. 7)**

167. There are two main types of cartridges in the service:-

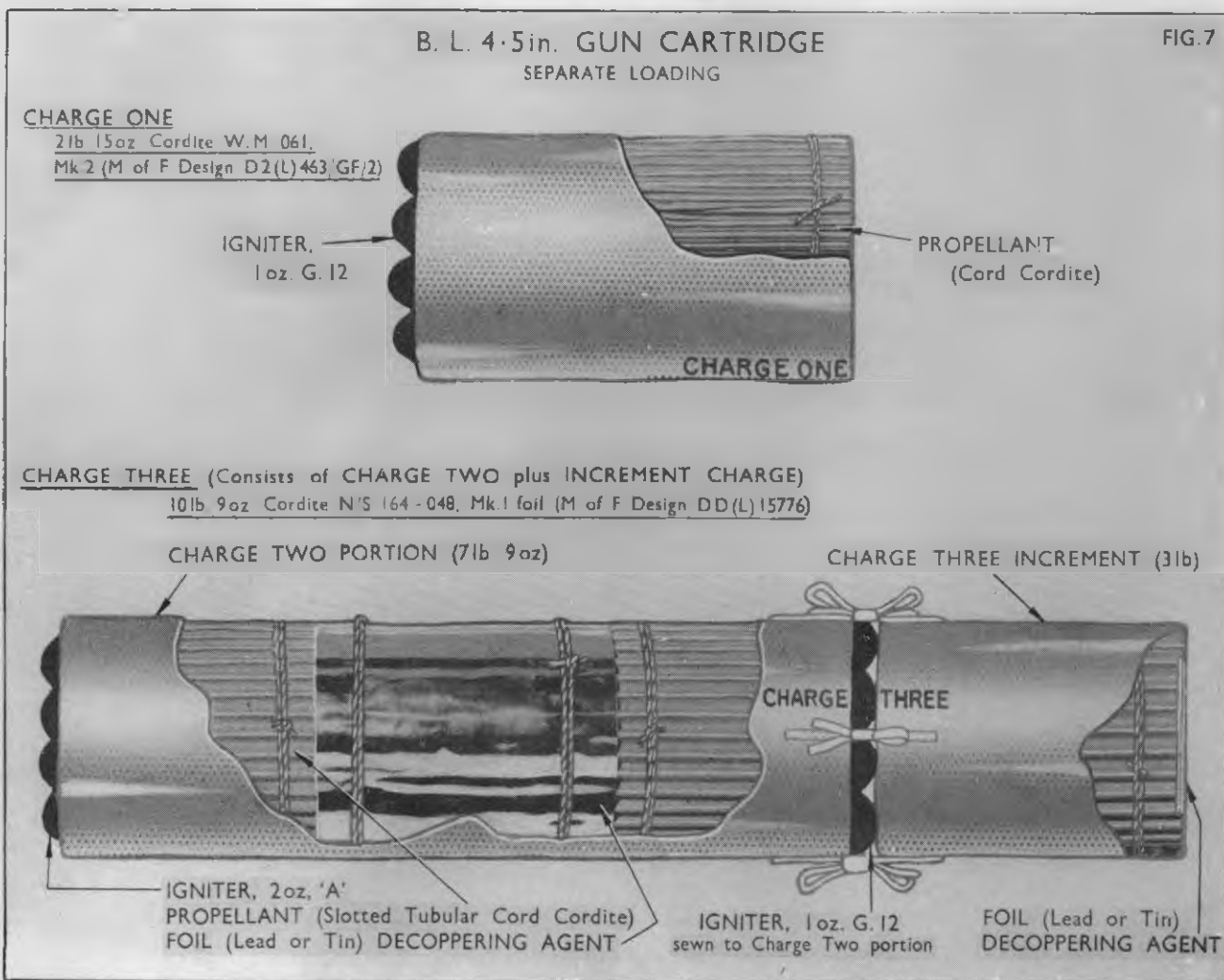
Charge 1

Charge 3

The charge three cartridge is made up in two portions, charge two and an increment tied together to provide charges of varying weights of propellant, thereby enabling suitable charges being used where variations of range and angles of descent are required. The increment charge is never fired separately. In addition, there is a charge for high angle fire, called charge one.

All charges are contained in silk cloth bags.

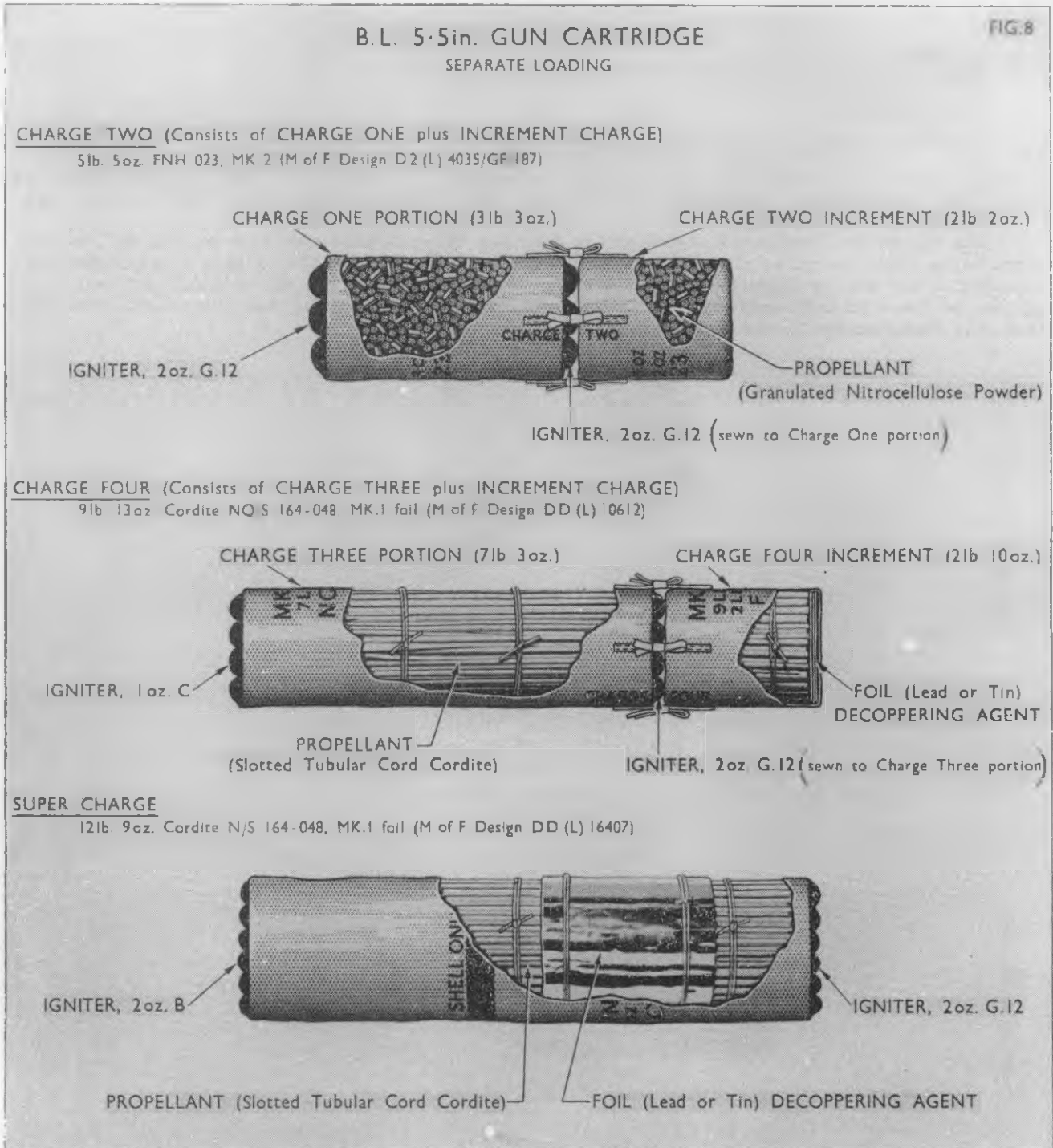
The charge two portion is closed at the rear end by an igniter stitched on, tin or lead foil discs being incorporated at the opposite end. The bag has four lengths of silk or shalloon braid stitched at one end by which the increment charge is secured to it. Later designs may have an igniter stitched to both ends with tin or lead foil sheet wrapped around the propellant, with tin or lead foil incorporated in the outer end of the increment portion.



168. Issue and preparation - The charges are issued and prepared for firing as follows:-

Charge 1 - A complete charge 1 is issued as a separate cylinder. It requires no preparation and cannot be used for building up charges 2 or 3.

Charges 2 and 3 - These charges are issued together, the complete unit as issued forming charge 3. To prepare charge 2, the portion marked three is removed. Charge 2 cannot be broken down to form charge 1.



B.L. 5.5 INCH GUN (Fig. 8)

169. There are four main types of cartridges in the Service, these being:-

- Charge 2 (short range portion)
- Charge 4 (long range portion)
- Super charge (for use with 80 lb. shell only)
- Paper shot

The cartridges in this instance also are enclosed in silk cloth bags to which a gunpowder igniter is stitched to the end which is loaded nearest the tube.

In order that variable charges may be used, they are made up in different weights of propellant. Charge three and an increment charge tied together form charge four. Tin or lead foil discs are incorporated with the increment charge, which is never fired separately.

There is also a super charge marked "for 80 lb. shell only", this is also identified by a 1 inch wide black band placed 7 inches from the end of the charge.

170. Issue and preparation - The charges are issued and prepared for firing as follows:-

- Charges 1 and 2 - These charges are issued together, the complete unit as issued forming charge 2.  
To prepare charge 1, the portion marked TWO is removed. These charges cannot be used for building up charges 3 or 4.
- Charges 3 and 4 - These charges are issued together, the complete unit as issued forming charge 4. To prepare charge 3, the portion marked FOUR is removed. Charge 3 cannot be broken down to form charges 1 or 2.
- Super Charge - This charge is issued as a separate complete unit. It requires no preparation and cannot be broken down to form charges 3 or 4.

B.L. 7.2 INCH HOWITZER (Fig. 9)

171. There are three main types of cartridges in the Service, these being:-

- Charge 3
- Charge 4
- Charge 5 increment.

The charge 3 cartridge is made up in portions to provide charges of various weights of propellants, thereby enabling suitable charges being used where steep angles of descent and variations in range are required. Each portion is enclosed in a silk-cloth bag, the No. 1 portion has a head and core while Nos. 2 and 3 portions are of different weights and are shaped to fit around the core of the No. 1 portion.

No. 1 portion is always fired. It may be augmented by portions Nos. 2 and 3, the three portions making a full charge. An igniter is affixed to the base of portion No. 1 and two tapes, 1 inch wide, are stitched diametrically opposite each other to the sides of the bag to secure Nos. 2 and 3 portions.

No. 2 and 3 portions vary in depth according to the quantity of propellant in each. They are secured and tied tightly around the core by webbing braid sewn to the cloth and the ends tied in a bow. Two 1 inch tape fairleads are sewn to the cloth of each portion for the tapes of No. 1 portion to pass through, the latter being secured by a bow tie on top of the No. 3 portion.

Other designs of charge 3 cartridges differ from the above in that the three portions are all made up cylindrical in shape, differing mainly in depth according to the quantity of propellant in each. The three portions are secured end to end by webbing ties.

The charge 4 cartridge is issued as a complete unit. The propellant is contained in a cylindrical silk-cloth bag. Cartridges filled FNH have a gunpowder igniter attached to the base of the bag, while the mouth of the bag is choked with silk thread. Cartridges filled N/S have an igniter affixed at each end.

A charge 5 increment, which has an igniter affixed at each end, is provided to form a super-charge for use with charge 4 in mark 6 howrs. only.

172. Issue and preparation - The charges are issued and prepared for firing as follows:-

- Charges 1, 2 and 3 - (WM, N or FNH propellant) - The charges are issued together, the complete unit as issued forming charge 3. To prepare charge 2 the portion marked "3" is removed. To prepare charge 1 the portions marked "2" and "3" are removed.
- Charge 4 (FNH or N/S propellant) - This charge is issued as a separate unit. It requires no preparation and cannot be broken down.
- Charge 5 - This charge is obtained by adding a charge 5 increment to the charge 4 unit. Care should be taken, where possible, to ensure that the charge 5 increment and the charge 4 unit are of the same propellant nature.

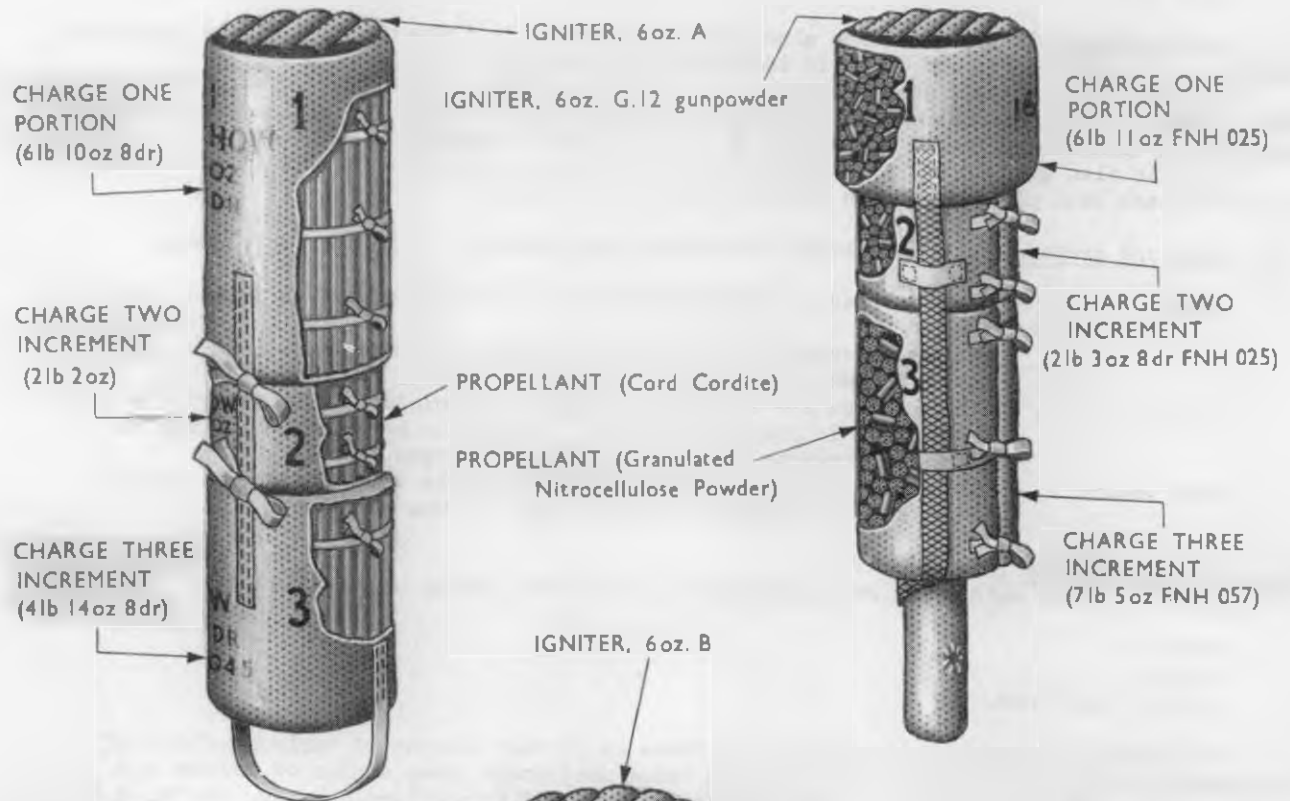
### B.L. 7-2 in. HOWITZER CARTRIDGE

FIG. 9

#### CHARGE THREE (Consists of CHARGE ONE plus INCREMENT CHARGES)

13lb. 11oz. Cordite N 045 MK.1  
(M of F Design DD (L) 16276)

16lb. 3oz. 8dr. FNH 025 and 057 MK.1  
(M of F Design DD (L) 13658 A)



#### CHARGE FOUR

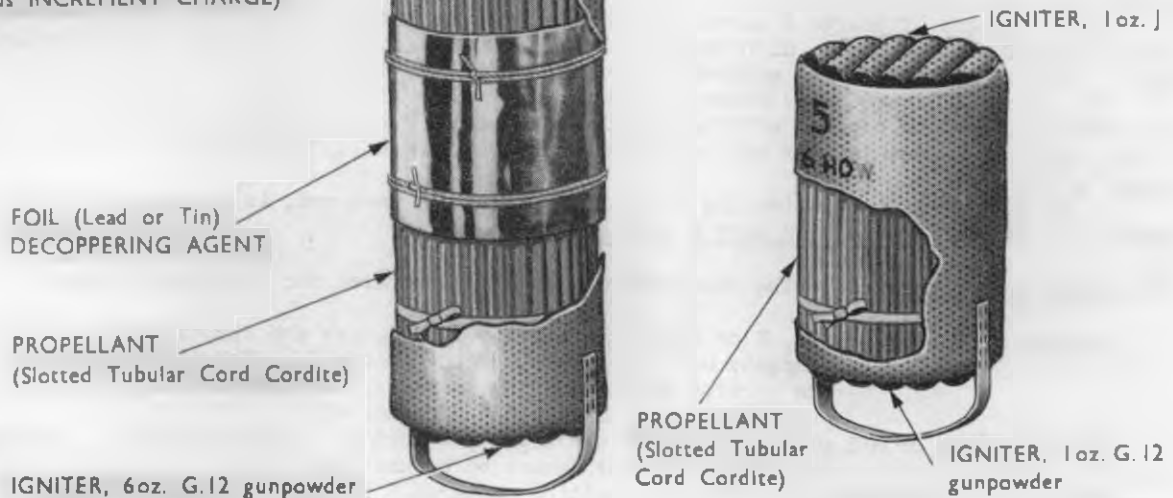
24lb. Cordite N/S 198-054 MK.1 foil  
(M of F Design DD (L) 16485)

#### CHARGE FIVE (Consists of CHARGE FOUR plus INCREMENT CHARGE)

#### CHARGE FIVE INCREMENT (7lb)

(for MK.6 Howitzer only)

Cordite N/S 198-054 MK.1 foil  
(M of F Design DD (L) 19907)



## Chapter 4 Means of Ignition

### Section 1. Introduction

#### IGNITION OF THE PROPELLANT CHARGE

173. The propellant charge is ignited by the firing of an igniferous initiator, i.e., by the impact of a striker on to a percussion cap assembled in the base of the primer or tube. The small flash given by the initiator i.e. the percussion cap is picked up and amplified by a gunpowder charge contained in the magazine portion of the primer or tube. This charge is normally sufficient to ensure that the space in the chamber of the gun surrounding the propellant charge is rapidly filled with gases of sufficient temperature and heat content to ensure even and rapid ignition of the propellant over the whole of its surface.

Only with uniform ignition will regularity of ballistics be achieved.

The amount of gunpowder used in the primer or tube depends upon the chamber dimensions of the gun, the size of the propellant charge and the ease with which it is ignited i.e., upon the nature of the propellant.

174. Q.F. cartridges - As the flash from the primer is not sufficiently powerful to ignite the charge with certainty and regularity, certain charges, depending upon the nature of the propellant, are assembled with a supplementary igniter which is positioned in the base of the charge so that it is in direct contact and augments the gunpowder charge in the magazine of the primer.

175. B.L. cartridges - As the flash from the tube is not sufficiently powerful to ignite modern propellants with certainty, smoothness and regularity, a charge of gunpowder enclosed in a shallow bag termed an igniter, is attached to the base or breech end of all B.L. cartridges. This igniter is of the largest possible diameter and is designed and positioned so that some part of the gunpowder will encounter the flash from the tube and thus ensure good and uniform ignition of the whole of the propellant charge. To achieve this requirement the distance between the tube and igniter must not be excessive.

## Chapter 4 Means of Ignition

### Section 2. Primers

#### GENERAL

176. Primers are the means employed for initiating the propellant charge in most modern Q.F. equipments.

The igniferous initiator in the cap and the gunpowder in the magazine of primers, if allowed to become affected by damp, will cause misfires and hangfires.

With some primers and propellants an igniter is used to reinforce the flash from the primer and ensure efficient ignition.

Primers can be repaired and used again.

Primers should invariably be removed from the cartridge case should it ever be necessary to use force to get the case into the breech of the gun. This particularly applies to any form of hammering, as not only might the primer cap be struck by accident but the shock might well damage it. The primer can be replaced once the case is fully home.

#### PERCUSSION - DESCRIPTION (Fig.10)

177. The percussion primer contains three main elements; the cap, gas check and magazine.

178. Cap - This consists of a small copper shell containing about 1 grain of cap composition, covered with a tin foil disc and assembled with a fillet of waterproofing composition in the primer, with the open end close to an anvil and nearest to the magazine. Either D.C.A. or Q.F. composition may be used. D.C.A. is somewhat more sensitive and provides more certainty in action, but experience has shown that if primers containing this composition are rammed home by a power rammer and subsequently unloaded there is a serious risk that they will function prematurely when next rammed into the gun. In fact, a primer containing D.C.A. must not be power rammed a second time, but should be removed when the round is unloaded and replaced by a new primer. Primers containing

D.C.A. ("A" composition) are not specifically marked but all primers containing Q.F. composition subsequent to the end of 1939, have the letter "Q" stamped on the base. Some of the packages containing cartridges fitted with these primers had the letter "Q" stencilled on the ends, but this has since been discontinued.

The cap composition is initiated by the cap being driven down onto the anvil by the striker of the firing mechanism.

179. Gas check - The obturation or prevention of gas escape through or past the primer is of great importance as gas wash may cause serious damage to the breech mechanism.

Rearward escape of gas through the primer is prevented by a copper ball or cone which is contained in a central recess in the anvil and retained by a plug. This recess is connected by fire holes in the anvil to the cap and by fire holes in the plug to the magazine. This arrangement permits the flash from the cap to pass to the magazine, but the ball or cone is forced back on to a seating by the explosion of the primer magazine and thus seals the fire holes in the anvil.

180. Magazine - The compartment housing the gunpowder is designated the magazine and may be formed as an integral part of the body or it may be a separate component screwed on to the primer body. Its length may vary within wide limits in different descriptions of primers. It contains gunpowder, usually G.12.

Integral magazines have a closing disc securely fixed to the body but weakened to provide an easy opening without fracturing, as debris in the bore might be troublesome.

The separate magazine is provided with fire holes, and a liner prevents escape of the powder, the liner being also varnished with shellac varnish as a protection against damp. Some of these magazines have a fire hole at the forward end and to prevent accidental perforation of the liner by the propellant, this hole is covered by a white metal "dome", the white metal of which also acts as a decoppering agent.

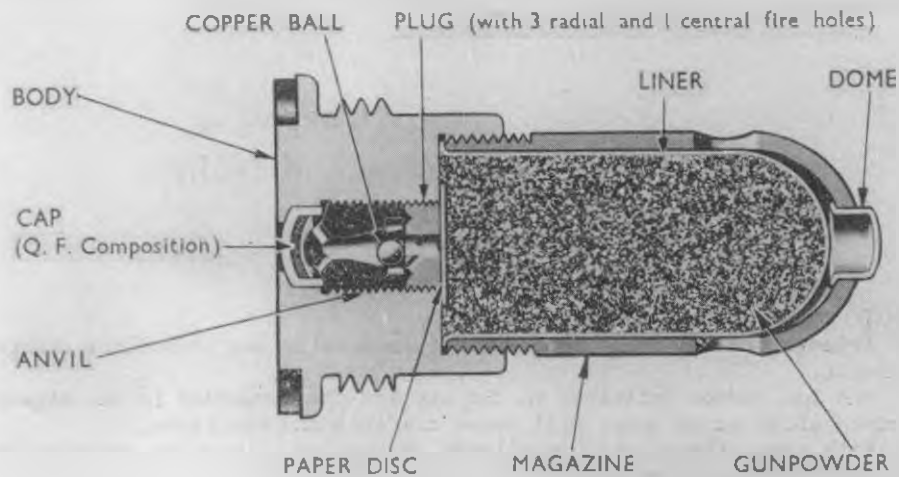
FIG. 10

TYPICAL PERCUSSION PRIMER

Exterior view



Screw - threaded to suit Cartridge Case



Action of gas - check upon firing





ACTION (Fig. 10)

181. The striker of the firing mechanism is driven on to the cap (or cap holder) and the composition is nipped on the anvil. The flame passes through the fire holes in anvil and plug, past the ball or cone and ignites the gunpowder in the magazine. The resultant explosion forces the ball or cone back on to its seating preventing internal gas escape to the rear, and travelling forwards through the closing disc or fire holes ignites the propellant charge.

## Chapter 4 Means of Ignition

### Section 3. Tubes

GENERAL

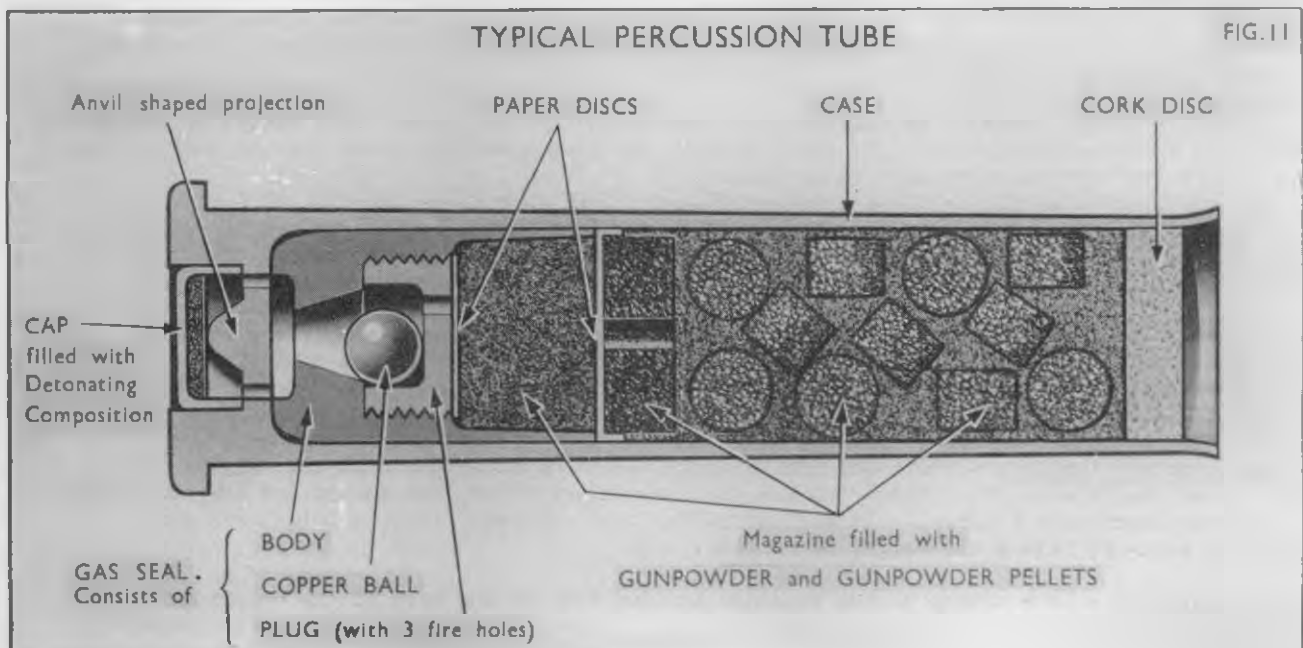
182. Tubes are used in B.L. guns and howitzers to initiate the propellant charge. The tube is assembled in the axial vent and on being fired produces a flash to ignite the cloth igniter attached to the base of the propellant charge. The flash should be as strong and regular as possible to ensure rapid and certain ignition of the cartridge igniter. As the distance between the rear end of the cartridge and the front end of the vent varies with the type of gun and the charge in use, the strength of the flash must be sufficient for the maximum distance that may be met. The gas sealing action of the tube in the vent is similar to that of a Q.F. cartridge in a gun chamber.

PERCUSSION. S.A. CARTRIDGE (Fig. 11)

183. The tube consists of a case, a cap above which is an anvil and gas seal with copper ball. The forward part of the case being the magazine which is filled with gunpowder, the mouth being closed by a cork plug.

ACTION

184. When the percussion mechanism is operated, the cap is struck by the point of the firing pin, so that the detonating composition is pinched between the anvil and the interior base of the cap, and thus fired. The resulting flash passes through the three holes in the plug to ignite the powder in the magazine which, in turn, ignites the cloth igniter attached to the base of the propellant charge. The soft copper ball is driven to the rear by the explosion in the magazine and the wall of the case is expanded radially so preventing escape of gas to the rear from the tube chamber in the axial vent. The action of the gas seal inside the tube is, therefore, similar to that employed in percussion primers (see Fig. 10).



## Chapter 4 Means of Ignition

### Section 4. Igniters

#### GENERAL

185. Igniters consist of a supplementary charge of gunpowder and are used to augment the flash from the tube or primer so as to ensure regular and rapid ignition of the propellant charge over the whole of its surface.

There are three main types i.e.:-

B.L. cartridge igniters ) in bag form

Q.F. cartridge igniters )

Q.F. and R.C.L. cartridge igniters ..... metal

The latter are not used, at present, in any Field Branch Artillery ammunition.

186. Q.F. cartridge igniters - Some Q.F. cartridges employ a supplementary igniter to boost the flash from the primer magazine. It is usually in the form of a shaped bag filled with a small quantity of gunpowder and is positioned at the bottom of the propellant charge so that it is in direct contact with the magazine or body of the primer. The three types of supplementary igniters are:-

Core igniters

Bandolier igniters

Flat or disc shaped igniters.

187. B.L. cartridge igniters - Secured to one or both ends of every B.L. cartridge is an igniter consisting of a small charge of G12 gunpowder enclosed between shalloon or worsted cloth discs. The cartridge is loaded into the ordnance with the standard igniter nearest to the end of the vent.

An igniter is required as the flash from the tube is not sufficiently powerful to ignite modern propellants with certainty and regularity. To effect this the gunpowder must be uniformly distributed throughout the igniter, and should completely fill the stitched compartments provided i.e., there must be no danger of the gunpowder shaking down to the bottom of the packets.

To obtain certainty of ignition, it is most important that igniters should be protected from damp. The sealed case or cylinders in which the cartridges are packed should not be opened sooner than necessary and, if opened, the lids or covers should be replaced and resealed with fresh luting.

188. Standardized igniters - The old type of igniter was cross-stitched radially into two or more compartments. It is now obsolescent and the standardized igniter is generally employed. This type is cross-stitched into parallel compartments which are filled with G12 gunpowder.

The igniter consists of two discs of shalloon or worsted cloth, dyed red, between which gunpowder is enclosed. A silk cloth disc is sewn to the underside of the igniter to prevent the cordite from penetrating the shalloon.

Standardized igniters for each calibre of gun may differ in weight and dimensions. The governing factor is the diameter of the charge to which they are attached. The weight of the gunpowder charge shown on the igniter (old type) is only the minimum weight which must be got in; the igniter must be well filled irrespective of weight.

The nomenclature of standardized igniters is determined as follows:-

A separate lettered series commencing with "A" is used for each calibre of gun or howitzer. A change in the size of the igniter or nominal weight of powder advances the nomenclature to the next letter, or, if the change is small, a star may be added to the letter in use.

189. Auxiliary igniters - These are issued for fitting over standard igniters if the standard igniter is suspected of being damp or has sustained damage sufficient to cause a misfire. A drawing of silk or worsted webbing is threaded around the edge of the igniter to form a skirt and to secure the igniter to the cartridge.

190. Supplementary igniters - Where one igniter only is assembled to the cartridge bag it is referred to as the "standard". Where two are used, one at each end, the second one may be referred to as the "supplementary" igniter. It will often be found, however, that both igniters are identical in make-up, nature and weight of filling.

191. Core igniters - In addition to the standard igniter sewn to the base of the cartridge bag, certain designs of B.L. cartridges may be made up with a core igniter which is assembled centrally in the charge. For example, the B.L. 5.5 inch 10 lb. 14 oz. 8 dr. N.H. O47, Mk. 1 foil cartridge is assembled with a  $1\frac{1}{4}$  oz. G12 gunpowder igniter inserted centrally in the charge, with the base thereof in contact with the standard igniter sewn on the bottom of the cartridge bag.

## Chapter 5 Projectiles

### Section I Introduction

#### GENERAL.

#### 192. Projectiles can be divided into two main types:-

- (a) Shell which carry a filling such as H.E., smoke, etc. They produce effect by the energy of their contents. Piercing shell produce effect by virtue of their striking energy as well as by the energy of the H.E. content.
- (b) Shot which are non-explosive and are used for the attack of armour and concrete. Their effect on armour and concrete is produced by virtue of striking energy only, which is derived from their weight and velocity.

#### 193. Requirements of projectiles - The design of a projectile must fulfil the following requirements:-

- (a) Target effect - The projectile must produce the desired results at the target (e.g. destruction by high explosive, armour penetration, etc.).
- (b) Ballistics - The design must enable the requirements for range, accuracy, velocity, etc. to be achieved.
- (c) Strength - The projectile must be strong enough to withstand the forces exerted on it while in the gun and, in the case of piercing shell, those forces due to the shock of impact.
- (d) Economy - It should be reasonably easy and cheap to produce and should be robust and easy to handle from a user point of view.

194. Forces acting on a projectile - For all projectiles other than those required for the attack of armour, by far the greatest stresses are imposed while the projectile is in the bore. With armour-piercing projectiles, the main problem is to prevent the projectile from breaking up on impact with the target, thus reducing its penetrating performance. The stresses to which it is subjected in this process are very much greater than any stresses met with in the bore.

Of the forces acting on the projectile while it is in the bore, the most important are those resulting from the acceleration of the projectile by the presence of the propellant gases on the base. Owing to this acceleration of the projectile and its components, each part exerts a considerable force on its supporting member. This force is usually referred to as the set back force.

Owing to the rotation of the projectile there is also a considerable centrifugal force acting on all parts.

Allowance must also be made in the design for the pressure exerted by the driving band on the body of the projectile. With heavy shell with a rear driving band only, the shoulder of the shell may be subjected to a series of heavy lateral blows as it passes up the bore, owing to the inadequate centring of the projectile by the band. This is referred to as side slap.

195. Factors affecting shape - The need for greater and greater ranges and also of greater penetration has influenced the shape of the projectile.

- (a) The amount of air resistance depends upon the size, shape and "presentation" of the projectile; upon size, because of the number of air molecules to be displaced by movement of the projectile; upon shape, because of the important effect it exerts on the manner in which the molecules are shouldered aside. "Presentation" affects both the number of air molecules displaced and the manner in which they are pushed aside. A projectile of two feet in diameter displaces four times as many molecules as does a projectile of one foot diameter, since the area of the cross section of a projectile varies as the square of the diameter. A cone with base diameter of two feet, since its greater cross section is the same as a cylinder of the same diameter, displaces just as many molecules, but, because of its pointed shape effects the displacement more smoothly and consequently encounters less resistance.

- (b) Weight exercises a great effect on the power to overcome resistance, since one of the factors upon which the energy of the projectile depends is its weight (the other is its velocity). Thus two cylinders of equal diameter and length composed of different materials, one twice as heavy as the other, would experience the same resistance in travel through the air, but the heavier one would possess double the power of the other to overcome it.
- (c) Again, since length has little effect on resistance, a cylinder twice the length of the original one and composed of the same material, if solid, would be twice as heavy and possess double the energy. In order that a cone possess the same energy as a cylinder of equal diameter, it must of necessity be longer (since it otherwise would be of less weight) and, as the length of the projectile is limited by certain other considerations, the modern projectile represents a compromise, combining energy-producing effect by means of increased weight and resistance-reducing effect by means of the pointed head.
- (d) The air resistance is affected in a marked degree by the shape of the head. It is found that, in a shell of the usual form, the shape of the shoulders is more important than that of the actual point. This is explained by the fact that, as air streams outward from the point to pass over the shoulder of the shell, it leaves a partial vacuum near the point, while the main air pressure comes near the shoulders. But, when a projectile with an ogive of five or six calibre or larger radius is used, the shape of the point becomes important, as determining the direction of the air currents which flow over the shoulders.
- (e) The ideal shape for a projectile intended to travel through the air with the minimum resistance would be one of streamline profile - one having a nose with an ogive curved for pushing aside the air molecules with the least disturbance, and a long tapered tail to eliminate vacuum forming eddies in its wake. The flat, sawn off bottom of the type of projectiles in use prior to and in World War I is inefficient, because the partial vacuum formed behind the projectile during flight greatly retards it and causes unsteadiness in flight. For this reason modern projectiles are of the boat tailed type.

196. Exterior of modern projectiles - Modern projectiles combine weight and force in the most practical way to secure a maximum of stability and a minimum of air resistance in flight.

The cylindrical surface in the rear of the driving band is coned slightly to form the boat tail, with an inclination of from six to eight degrees to the axis of the projectile. The ogive describes an arc whose centre lies on a line perpendicular to the axis of the projectile, with a radius usually expressed in terms of calibre. This radius formerly was two calibres for all projectiles, but experiments have proved that a marked reduction in air resistance, resulting in greater range, can be obtained by increasing the radius of the ogive to as much as 10 or 11 calibres.

#### COMPONENT DETAILS

197. Body - The bodies of all projectiles are manufactured from steel or iron, the type of which depends upon the use to which the projectile is put and the stresses to which it is subjected. The cylindrical portion is provided with a circumferential groove or grooves to accommodate the driving band or bands.

198. Shape of projectile - The important factors are the length of the head, the shape of the base, and the position of the driving band. With high velocity shell, the base drag is of minor importance compared to the head resistance. Such projectiles are normally made with the base cylindrical to improve stability, to give greater capacity and to ease production.

Projectiles whose velocity may fall below that of sound, 1,100 f.s. range further if they are given a tapered (streamline) base, as at these velocities the base drag is important.

199. Shape of head (Fig.12) - The head is ogival, that is to say, the parallel sides of the projectile are curved inwards forward of the shoulder to form a point. Some projectiles are more pointed than others and the actual shape is expressed according to the radius of the curve or ogive expressed in calibres and referred to as the "calibre radius head" or "CRH".

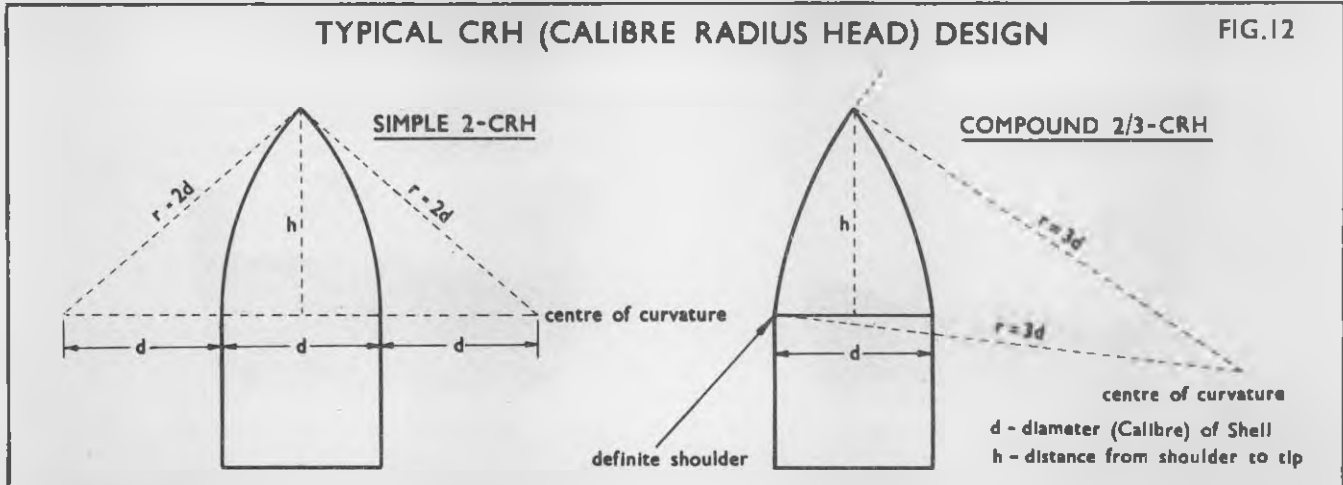
In general terms the larger the CRH the more pointed is the nose. "Simple CRH" is measured as the radius of curvature (r) of the nose. When curvature of the head is not "simple", i.e. when there is a definite shoulder (see Fig.12) the CRH is said to be "compound". In a compound CRH of 2/3, for instance, the distance from the shoulder to the tip is that of a simple CRH of 2 (h in Fig.12). The curve joining the tip to the shoulder is, however, drawn with a radius of three calibres. This has the effect of improving the ballistics of the projectile without altering its stability.

Some equipments have both simple and compound CRH shell. The ballistic qualities of the latter are assessed and these shell are given an equivalent or "Service" CRH. So in one equipment a shell of Service CRH 6 will range the same as one of simple CRH 6 at mean fighting ranges.

Prior to 1945, if the CRH exceeded two, it was indicated by the addition of a letter to the mark of the projectile according to the following code:-

CRH	Code Letter
From 2 to 4 .....	A
" 4 to 6 .....	B
" 6 to 8 .....	C
" 8 to 10 .....	D

The radius referred to above includes the fuze and/or ballistic cap when fitted.



200. Bases (Fig. 13) - With H.E. nose fuze shell in order to guard against the possibility of flaws in the centre of the base due to "piping" in the ingot and as a protection against propellant gases reaching the H.E. filling and causing a premature, a shallow recess is bored out and, after examination, a rolled steel plate or disc is inserted. The disc may be plain or screw-threaded and is finally secured by riveting. In current manufacture of Q.F. 25 pr. H.E. shell a disc is welded over the centre of the base.

Some projectiles have recesses formed in the base to take tracers or tracers and igniters, while others such as A.P. and H.E.S.H. shell are bored and screw-threaded to accommodate a base fuze and in some cases also a tracer.

Practice projectiles may be issued with the base solid i.e., not recessed and fitted with a plate or disc inserted.

Smoke, flare, incendiary and star shell are fitted with separately assembled solid bases which are usually retained in position by a few screw-threads or they may be plain in which case they are secured by shear pins.

201. Driving band (Fig. 13) - The position of the driving band is governed by several factors. From the point of view of stability both in the bore and outside, it should be as far back as possible. It must, however, be far enough forward to leave sufficient metal behind to support it during engraving and rotation and with streamline shell, it must be well forward (i.e. on the parallel portion of the shell body).

In fixed Q.F. ammunition sufficient space must be left to the rear of the band to allow adequately strong attachment of the case. The metal used is usually copper although various alloys of copper and nickel as well as sintered iron are also used.

The driving band serves the purpose of sealing the propellant gases behind the projectile, imparting a spin that continues throughout the flight of the shell and of centring the projectile in the bore of the gun.

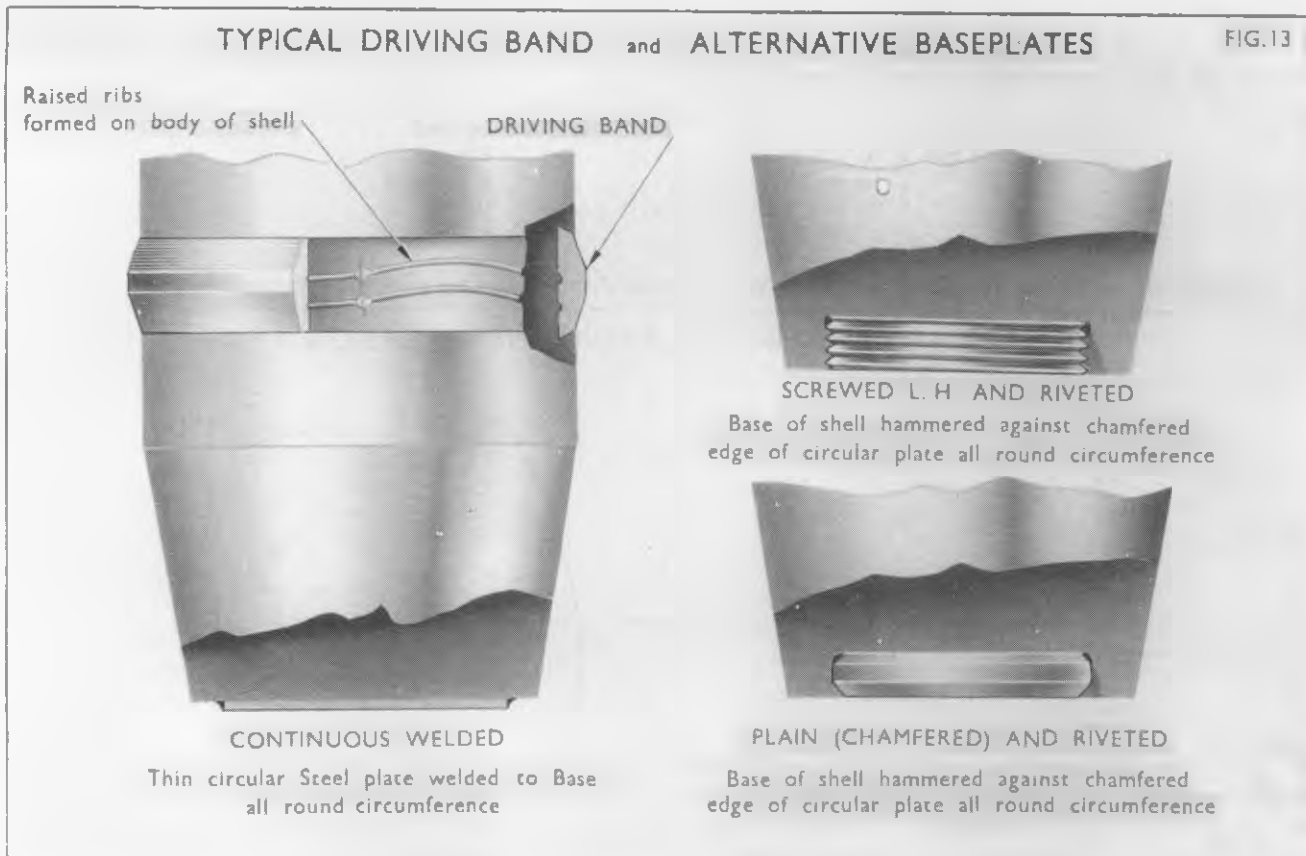
The rotation of spinning of the shell enables an elongated projectile to be used.

Accurate centring is seldom maintained except in the case of projectiles with forward as well as rear driving bands.

More than one driving band is often used for high velocity guns and the functions of sealing, driving and centring are variously shared by the bands according to the design.

In separate loading Q.F. and B.L. guns, the driving band also serves the additional purpose of a ramming stop, whereby the projectile is correctly positioned in the gun. The driving band engages with the shot seating when the projectile is rammed correctly, so preventing it from slipping back when the gun is elevated. Unless the projectile is in the correctly loaded position when the gun is fired, ballistic regularity will be adversely affected.

Copper driving bands tend to leave a deposit of copper in the bore, and in equipments where this tendency is pronounced the cartridges may contain "decoppering foil" to counteract it.



202. Coppering - This arises from the deposit of metal from the driving band on to the surface of the rifling of the ordnance. It produces irregular shooting and may lead to copper choke; it is indicated by the roughened appearance of the bore.

The copper can be removed from the gun by a chemical process, or by using tin or lead foil with the propellant charge. It may be prevented by using small quantities of tin or lead foil incorporated in each charge. The tin or lead foil combines with the copper to form a brittle alloy which is removed by the driving band of the next projectile fired. For some equipments special "decoppering" rounds or charges are provided. These usually contain twice the amount of tin or lead foil incorporated in the normal Service charge and are identifiable by the abbreviation "DEC" stencilled thereon.

PROJECTILE - DEFINITIONS (Fig. 14)

203. Ogive - This refers to the shape of the projectile from the shoulder forward. It does not include the fuze, although it may be prepared to accommodate one.

204. Head - The complete portion of the projectile forward of the shoulder. In certain carrier shell this may be manufactured as a separate component.

205. Walls - That part of the shell that surrounds the cavity. Usually from shoulder to commencement of streamlining, or base, if it is not stream lined.

206. Shoulder - The junction of the head with the remainder of the body, i.e., where the ogive joins the walls.

207. Bands - Portions of the shell walls formed immediately in rear of the shoulder or ogive and forward of the driving band which may be accurately machined to a greater external diameter than the rest of the shell body.

The front band is sometimes referred to, especially by the Americans and French, as "bourelet".

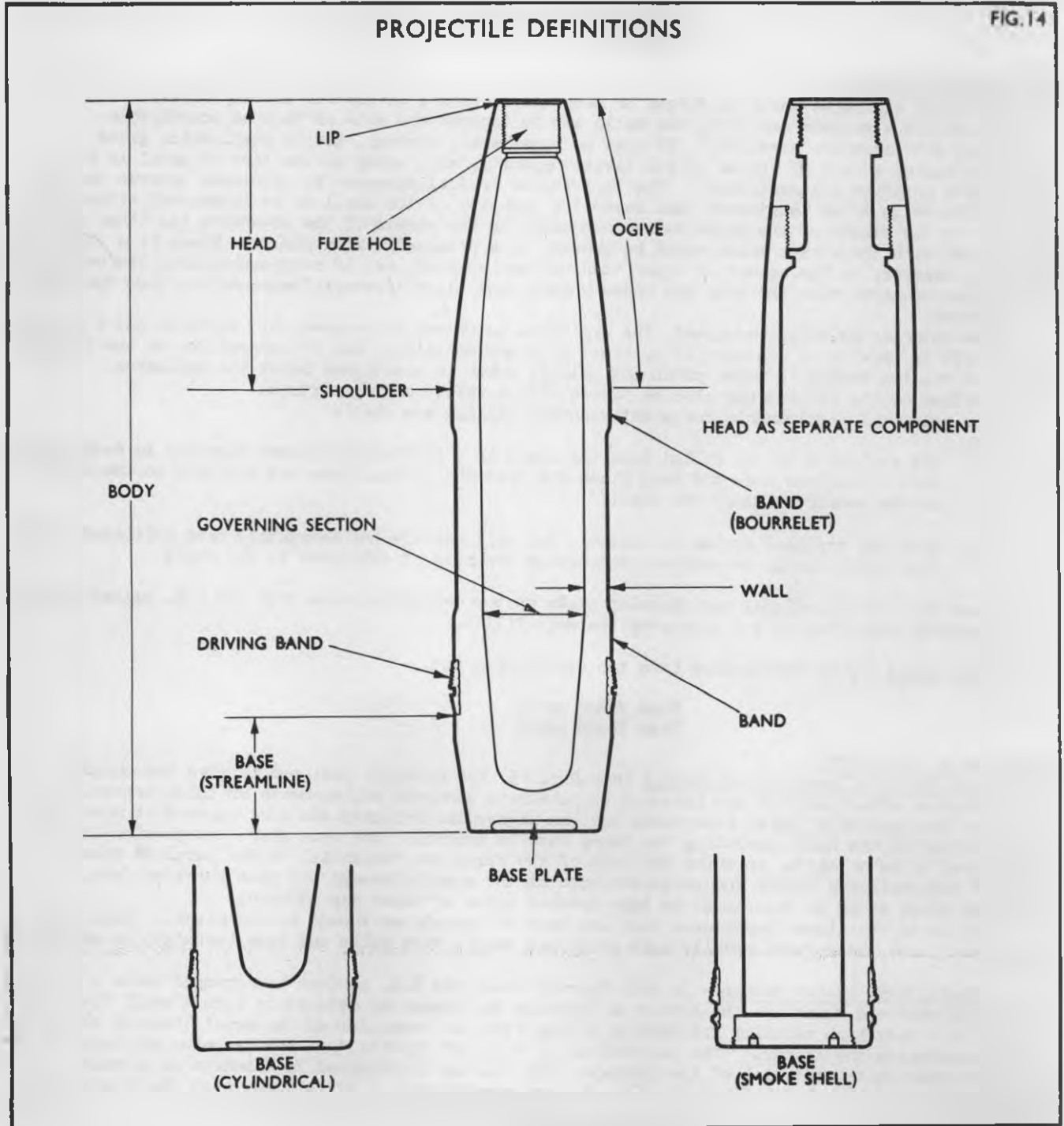
208. Base - In projectiles fitted with conventional driving bands, that part of the projectile in rear of the rear main driving band.

209. Body - The empty shell or shot, with driving band assembled, before filling with pay load, tracer or any other components.

210. Governing section - That part of the shell forward of the driving band at which the stress is a maximum.

211. Windage - The difference between the diameter of the bore and the diameter of the projectile (excluding the driving bands).

212. Capacity - Sometimes known as charge weight ratio or C.W.R. The ratio of the weight of the explosive bursting charge to the total weight of a filled shell, expressed as a percentage.



## Chapter 5 Projectiles

### Section 2 The Shell

#### GENERAL

213. Shell may be divided into two types viz:-

High explosive (H.E.)  
Carrier

#### HIGH EXPLOSIVE SHELL

214. The high explosive shell is forged or machined to form a cavity for the explosive.

To obtain a maximum capacity, the walls may be tapered and made as thin as practicable consistent with adequate strength. It must be remembered, however, that a shell which gives excellent mining effect by virtue of its larger capacity, may, owing to the lack of metal in its walls, give inferior fragmentation. The tapering or gradual decrease in thickness towards the head enables the walls to be lengthened, and hence the capacity of the shell to be increased, without an increase in the weight of the walls and consequently in the stress of the governing (or other section) as compared with the stress which would be present in a parallel walled shell. There is a limit in practice, however, to the amount of taper than can be imparted, as, if over-emphasized, the weakness of the head compared with the body may cause unequal and unsatisfactory fragmentation when the shell is detonated.

The interior is stove varnished, the explosive is poured or pressed into position and a central cavity left to receive an exploder(s) or steel exploder container, and if catered for on the relative method of filling design, a smoke producing pellet, which is positioned below the exploders. The upper surface of the filling may also be topped with a waterproofing mixture.

The principal requirements for a satisfactory filling are that:-

- (a) the explosive can be filled into the shell in a sufficiently dense form and in such a manner that cavitation does not take place and that the filling does not set back on the shock due to the acceleration of the shell.
- (b) that the exploder system is suitable and will amplify the detonating wave initiated by the fuse sufficiently to detonate completely the mass of explosive in the shell.

When the fuse functions, the exploder picks up the detonating wave from the C.E. pellet in the fuse magazine, amplifies it and detonates the main filling.

215. H.E. shell may be sub-divided into two categories, i.e.,

Nose fused shell  
Base fused shell

#### SHELL, H.E. NOSE FUZE

216. H.E. Shell of conventional design (see Fig. 15) are normally designed to give the maximum fragmentation effect and are not intended to penetrate concrete emplacements or thick armour. The shape of the head is of great importance and the higher the velocity the more pointed it must be. The exterior of the head, including the fuze, must be smooth. The best shape has previously been considered to be an ogive, in which the ends of the curve are tangential to the parallel sides. Most of the shells are formed and screw-threaded at the nose to accept a 2 inch threaded fuze, although other sizes of fuze-holes to take special types of fuzes may be used.

It is of the utmost importance that the risk of prematures should be minimized. H.E. nose fused shells are, therefore, usually made of forged steel, with walls and base (usually) in one piece.

217. Shell, H.E. hollow charge - In this type of shell the H.E. content is arranged round a hollow in the forward end which has the effect of focusing the energy of detonation into a small fierce jet moving at a very high velocity followed by a plug from the remainder of the metal liner of the core which penetrates the armour. The penetration of this jet depends upon the diameter and angle of the cone and also on the material of its lining. The filling is required to detonate at a short distance from the armour and is designed and fused accordingly. It is found that the penetrative effect is reduced by the spin of the shell; further development of these projectiles is, therefore, likely to be along the lines of fin stabilization.



TYPICAL H. E. (HIGH EXPLOSIVE) NOSE FUZED SHELL

FIG. 18

Exterior view



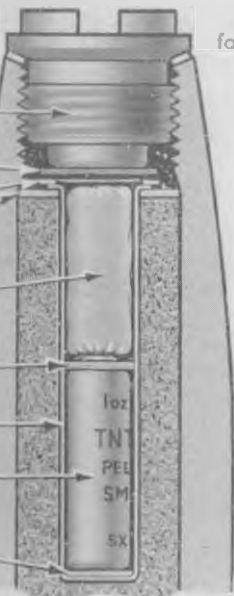
Sectional view



AMATOL filled

(M of F Design DD (L) 9028;

- FUZE HOLE PLUG
- CLOTH DISCS
- MILLBOARD WASHER
- FELT WASHER
- EXPLODER
- GLAZEDBOARD DISCS
- PAPER TUBE
- SMOKE PELLETT
- BOXCLOTH DISC
- MAIN EXPLOSIVE FILLING



Q.F.  
for 25 pr.

RDX TNT filled

(M of F Design D2 (L) 554/GF/229)

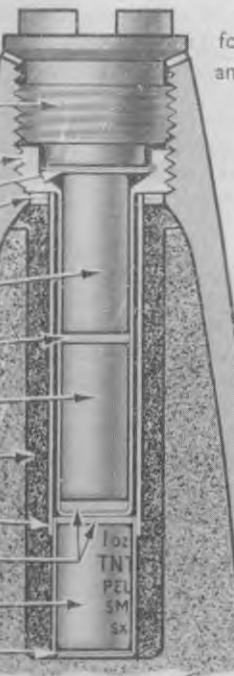


- FUZE HOLE PLUG
- PAPER DISCS
- EXPLODER
- INERT COMPOSITION
- PAPER TUBE
- TNT TOPPING
- FELT DISC
- PAPER DISCS
- EXPLODER
- FELT DISC
- MAIN EXPLOSIVE FILLING

AMATOL filled

(M of F Design DD (L) 16879)

- FUZE HOLE PLUG
- STEEL EXPLODER CONTAINER
- PAPER DISCS
- FELT WASHERS
- EXPLODER
- FELT DISC
- EXPLODER
- TNT SURROUND
- PAPER TUBE
- FELT DISCS
- SMOKE PELLETT
- CLOTH DISC
- MAIN EXPLOSIVE FILLING



B.L.  
for 4.5in.  
and 5.5in.

RDX TNT or TNT filled

(M of F Design D2 (L) 869/GF/235)



- FUZE HOLE PLUG
- PAPER DISCS
- PAPER COLLAR
- FELT WASHERS
- TNT TOPPING
- EXPLODER
- FELT DISC
- GLAZEDBOARD DISCS
- SMOKE PELLETT
- PAPER TUBE
- BOXCLOTH DISC
- MAIN EXPLOSIVE FILLING

218. The following complementary features will be found in Field Branch Artillery H.E. shell:-

- (a) Exploder containers - All B.L. amatol filled shell are fitted with a steel exploder container. B.L. 4.5 inch and 5.5 inch H.E. shell filled amatol to design DD(L)19506 are fitted with a container, steel, No. 4 or 27, while B.L. 7.2 inch howitzer H.E. shell filled amatol to design DD(L)19507 are fitted with a container, steel, No. 3. All other B.L. amatol filled shell are fitted with container, steel, No. 1.
- (b) Smoke boxes and pellets - Shell fitted with red phosphorus smoke boxes have been found to suffer from phosphoric acid exudation owing to moisture entering badly sealed ones. All such smoke boxes are being replaced by a 1 oz. 8 dr. TNT/aluminium smoke pellet as smoke production is still an observation requirement of Field Branch Artillery.
- (c) Surrounds and toppings - T.N.T. surrounds or toppings are used with amatol filled shell, waterproofing composition or T.N.T. toppings are used with R.D.X./T.N.T. fillings.

#### SHELL H.E. BASE FUZED

219. Squash head - Here the H.E., usually RDX/BWX or plastic explosive, is contained in a very thin walled shell. On hitting the armour, the shell collapses and the H.E. filling squashes up into a "plaster" on the face of the plate. A base fuze is so designed that detonation takes place immediately this "plastering" action is complete, causing a scab to be blown off the inside of the plate with considerable velocity. The blast effect on the outside is also very great and damage to the tracks, turret, ring, etc. is likely to be caused. The plastering action is not materially affected by the angle of incidence until it becomes very large, and the performance of this projectile is, therefore, practically independent of angle of incidence.

#### CARRIER SHELL (Fig. 16)

220. These contain a small bursting charge for the purpose of opening the shell and liberating its contents. Such shell may be made to burst on impact or in the air. Typical fillings of carrier shell are:-

Smoke (screening or coloured)	Chemical (liquid filled)
Flare (coloured)	Star (with or without parachute)
Incendiary	

Carrier shell are of two main types, viz:-

- (a) Bursting shell - These are usually made to burst on impact by means of a percussion fuze. The small bursting charge is sufficient to break open the shell and release its contents. The main disadvantage of this type of shell is that, even with a direct action fuze, the contents are carried by remaining velocity into the ground, thus reducing their effectiveness.
- (b) Base ejection shell - The majority of modern carrier shell are of this type. At the required point on the trajectory a time fuze ignites the burster (expelling) charge which blows out the base of the shell and ejects the contents; it may also, as in the case of, e.g., smoke shell, ignite the containers which it ejects.

#### SHELL SMOKE B.E. (Fig. 16)

221. These are base ejection shell having a steel body and base. The head of the shell, which may be fitted with a separate head, is bored and screw-threaded to receive a standard 2 inch time and percussion or time fuze or a plug, fuze-hole, 2 inch No. 1. Immediately below the fuze-hole a diaphragm with a central hole is formed in the head, a tinned-plate disc being soldered over the hole.

A cavity below the diaphragm accommodates a gun-powder burster (expelling) charge contained in a shallow bag. The smoke composition is contained in a number of mild steel containers which have a perforated central tube. The perforations permit the ignition of the composition which on burning is emitted through the same holes. A baffle plate is positioned between the burster charge and the upper smoke container. A hole through the centre of the baffle plate is covered by a paper disc secured with shellac. The shell is closed by a lightly screwed in base assembled over millboard washers and, in certain designs, a copper disc.

On the fuze functioning, the burster in the head of the shell is ignited. The resulting flame passes through the hole in the baffle plate and down the central hole in the smoke containers, then passing through the perforations in the tube of the containers it ignites the priming composition; at the same time the pressure on the surface of the baffle plate causes the base of the shell to be sheared-off and the containers ejected. The containers may be filled with either screening smoke compositions or smoke mixtures giving a red, blue, green or yellow colour. Smoke shell filled with coloured smoke mixtures are used mainly for target recognition and/or for signals. Containers of different colour composition are not mixed in the same shell. The shell are marked, designated, accounted for and issued according to the individual characteristics of the smoke produced.

### TYPICAL B.E. (BASE EJECTION) CARRIER SHELL

FIG. 16

Exterior view for Smoke, Flare and Incendiary shell

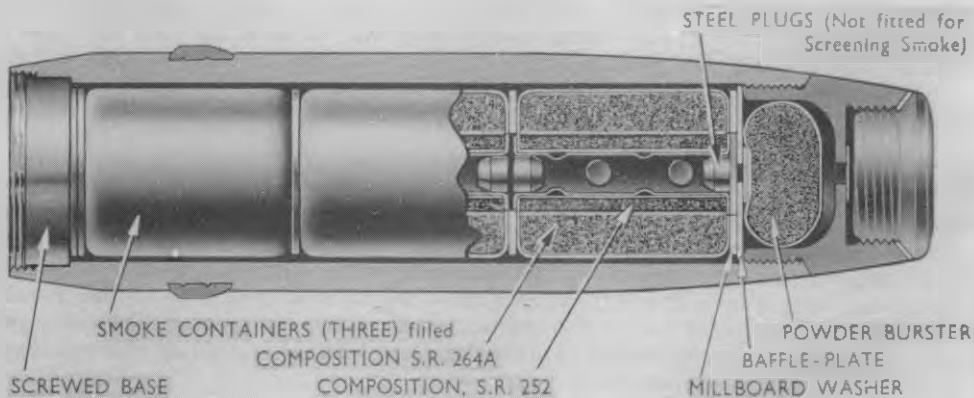


Exterior view for Star shell



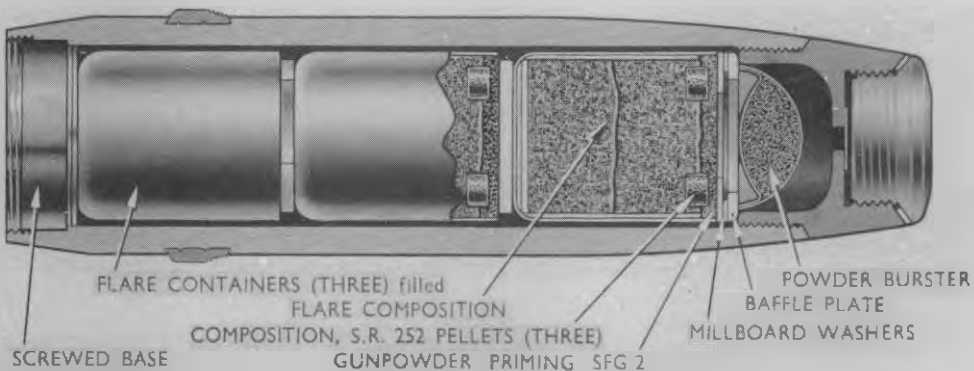
#### SCREENING OR COLOURED SMOKE

25 PR. (M of F Design D2 (L) 1528;GF, 135)



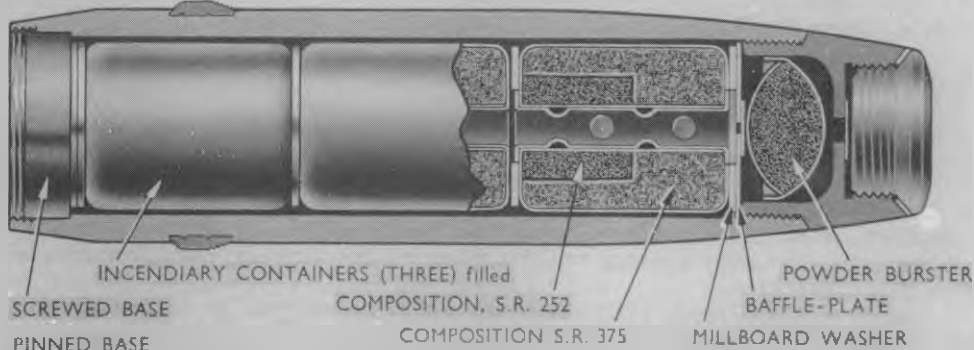
#### FLARE

25 PR. (M of F Design D2 (L) 449;GF, 193)



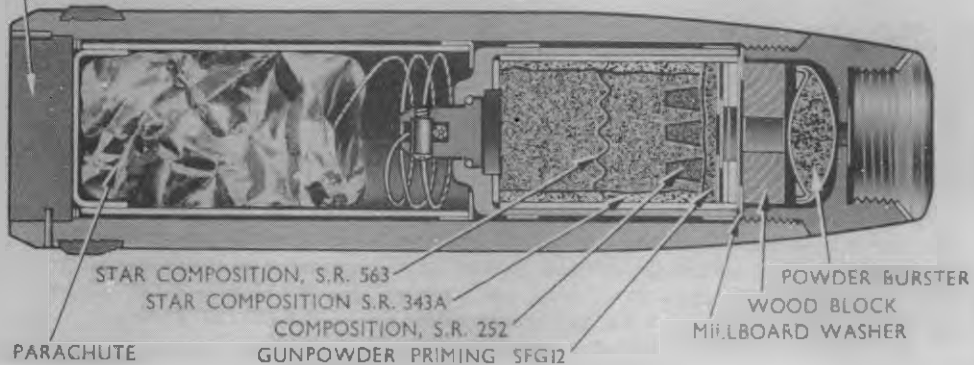
#### INCENDIARY

25 PR. (M of F Design DD (L) 11182)



#### STAR

25 PR. (M of F Design DD (L) 17894)



#### CONTAINERS SMOKE

222. Shell, Q.F. 25 pr. B.E. smoke - There are two variations of steel container, smoke, No. 3 Mark 2 viz., container smoke, B.E. (for use with streamline B.E. screening smoke shell) the central tube of which is not fitted with steel plugs, and container, coloured smoke (for use with streamline B.E. coloured smoke shell) the central tube of which is fitted with a drilled steel plug at each end.

223. Shell, B.L. 5.5 inch B.E. smoke - The mark 1 screening smoke shell are fitted with 6 steel containers, No. 6 mark 1 whilst the mark 2 shell are fitted with 4 steel containers No. 17 Mk. 1. The central tube of the containers used in screening smoke shell are not fitted with steel plugs.

The mark 1 coloured smoke shell are fitted with 6 steel containers, No. 6 mark 1 whilst the mark 2 shell are fitted with 4 steel containers No. 17 mark 1. In the case of the mark 1 green, red, and yellow smoke shell the central tube of the container is fitted with a drilled steel plug at each end. Similarly steel plugs are also fitted in each end of the central tube of the containers assembled in the mark 2 red coloured smoke shell.

#### STEEL PLUGS IN COLOURED SMOKE CONTAINERS

224. The reason for the use of steel plugs inserted in each end of the central tube of smoke containers used in certain coloured smoke shell is that coloured smoke compositions are based on ingredients giving a cooler burning than those used for the production of screening smoke. This is to avoid destruction of the dye. The coloured smoke composition burns relatively slowly in the container and vapourises the dye which condenses in the open air. The steel bushes are inserted in each end of the central tube of the container in order to prevent inflaming which would otherwise destroy the coloured smoke emission, at the same time it slightly reduces the rate of burning thereby prolonging the time of emission.

#### SHELL, FLARE, B.E. (Fig. 16)

225. These shell are similar in every respect to B.E. smoke shell differing only in that the containers are filled with S.R. flare composition which may be one of three colours i.e., red, green or yellow. Containers of different colour composition are not mixed in the same shell. Coloured flare shell are used for the same purposes as coloured smoke shell, but are more particularly useful for night identification.

The steel containers differ from those used in smoke shell, in that they have no central ignition and emission tube. Flare containers are ignited and burn from the top surface layer by layer thereby producing a flame which is emitted over the whole of the surface area. Ignition is facilitated by a layer of gunpowder S.F.G. 2 underneath which is a number of pellets of S.R. 252 composition inserted in the top surface of the coloured flare composition.

#### SHELL, INCENDIARY B.E. (Fig. 16)

226. These are similar in design and filling to B.E. smoke shell differing mainly in that the mild steel containers are fitted with incendiary composition. The method of functioning is also identical with B.E. smoke shell.

#### SHELL CHEMICAL B.E.

227. These are similar in external shape to B.E. shell. The burster consists of a bag containing G.12 gunpowder below which is assembled one or more bakelite smoke boxes filled red phosphorus inserted in the burster container.

A piston, in the form of a cupped ring secured to the lower end of the burster container by a nut, is used in the earlier designs, to eject the chemical charging through the lightly closed base of the shell when the burster container is fractured at the groove near its base by the explosion of the burster. In later designs the diameter of the burster container has been increased and the piston dispensed with.

The type of chemical with which the shell is charged is indicated by a code letter and number stencilled on the body of the shell.

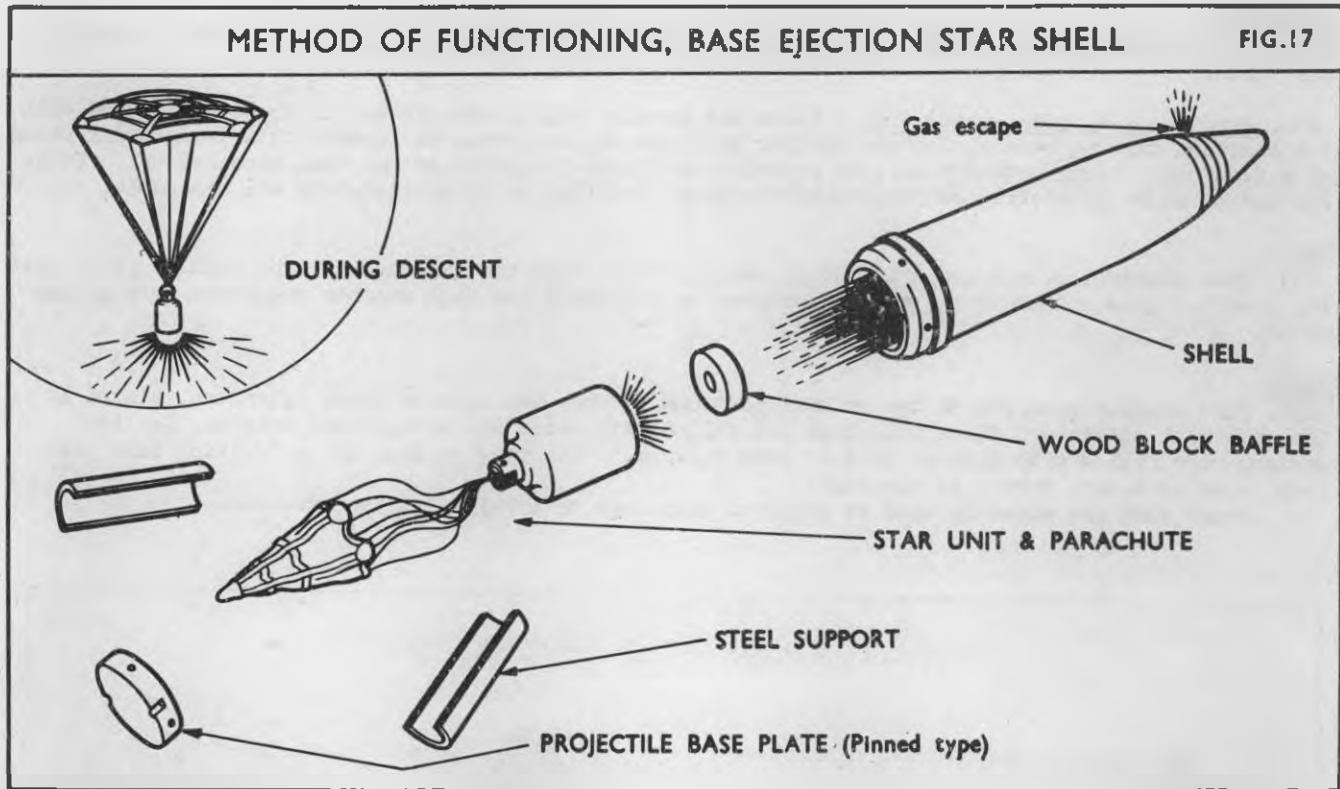
#### SHELL STAR, B.E. (Fig. 16)

228. This is a thin walled shell similar in design to the B.E. smoke shell except that star shell differ from smoke, flare and incendiary shell in that the base-plate is plain, not screw-threaded, and in being only lightly secured by a number of shearing pins. The main reason for this difference is in order to prevent damage to the parachute at the time of ejection, a very small burster (expelling) charge is used, and consequently the force transmitted to the baffle plate and hence on to the base plate is much less than that required to blow-out a screwed base plate.

Star shell should never, therefore, be stood on their bases but should be kept boxed. A drop of two feet on a hard surface is sufficient to bend or even break the shear pins which secure the base.

Incidentally, although termed "star" shell, such shell are usually fitted with parachutes; the container attached thereto providing an intense and brilliant white light. A more apt nomenclature would, therefore, have been to introduce them as illuminating shell.

For method of functioning see (Fig. 17).



**PRACTICE PROJECTILES**

229. Practice projectiles are used for practice firing, training in accuracy and spotting. They are usually of the H.E. type of shell except that the filling is an inert substance such as sand or H.E. substitute (abbreviated HE<sub>2</sub>SUB) although special empty projectiles may be approved.

Chapter 5  
Projectiles

Section 3 Shot

**GENERAL**

230. The term "shot" applies to projectiles containing no explosive as the main filling or bursting charge although most shot are fitted with tracers to assist observation of their flight.

Armour piercing shot are provided for use in anti-tank or anti-ship role for the attack of armour, concrete, etc.

Penetration of armour by shot causes damage in proportion to the remaining forward and rotational velocity of the shot and the confinement of space beyond the armour of the target. Additional damage is also inflicted by the projection of the "plug" of armour ahead of the shot, occasional break-up of the shot during penetration, flaking of the armour and by concussion.

Generally speaking, the thicker the armour to be penetrated, the higher must be the remaining velocity. At a certain velocity, however, the head of the steel shot will shatter before penetrating. In fact trials have shown that a given shot will shatter say, 2,500 f.s. against a plate which it penetrates at, say, 2,200 f.s. Hence the relative effectiveness of AP and APC shot.

**ARMOUR PIERCING (A.P.) (Fig.18)**

231. A.P. shot are of forged steel and pointed, the radius of the head being usually less than two calibres as a more pointed head tends to break upon impact. The head is hardened to penetrate the target but the hardness decreases progressively towards the base in order to allow increased toughness to the body and thus reduce the incidence of break up. It has the highest possible piercing performance which is obtainable under the conditions of manufacture.

**ARMOUR PIERCING, CAPPED (A.P.C) (Fig.18)**

232. A.P.C. shot - are A.P. shot fitted with a penetrative cap of hardened alloy steel whose function is to assist the point of the shot at the moment of impact and help its entry into the plate. The cap increases the maximum penetrative performance of the shot considerably.

**PRACTICE**

233. Practice shot are designed to give the same ballistics as A.P. shot, but are normally made of cast iron.

234. Practice F.H. (flat-head) shot - These are usually solid, cylindrical in shape and fitted with the standard driving band. Certain earlier patterns may, however, be found with a truncated instead of a flat head, being ordinary A.P. or practice shot with the point of the head machined off. It is for use on short or restricted ranges where reduced penetration or no ricochets are desirable.

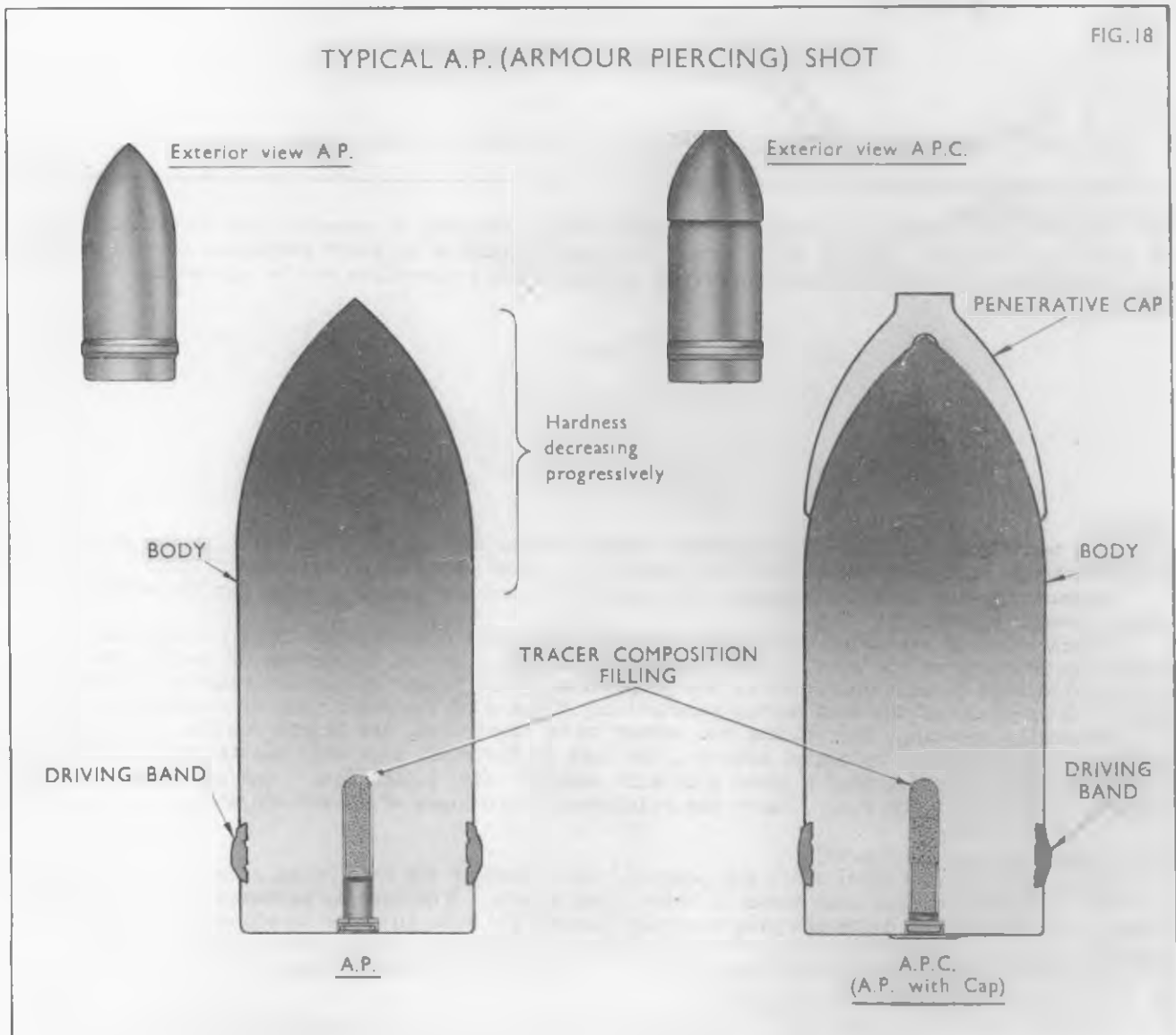
**PROOF**

235. This consists of a solid cylinder of steel, fitted with the standard driving band. It is used for proof of guns and mountings and is designed to withstand the high chamber pressures used at gun proof.

**PAPER**

236. This usually consists of two or more portions. They are made of paper cylinders, closed at the ends with strawboard discs and plugs and filled with water to the approved weights. Earlier designs were filled with diamond grit or iron filings. The rear portion has a "driving band", or stop, also of board, formed at the rear.

Paper shot are normally used at proof of mountings to simulate firing stresses.



## Chapter 6

### Fuzes

#### Section I. Principles etc.

##### INTRODUCTION

237. In general, a fuze acts in conjunction with an exploding system, to ensure the correct functioning of the bursting charge in a projectile, bomb or mine.

By far the greatest variety of fuzes are to be found in projectiles fired from artillery weapons. These may be classified in a number of ways, thus:-

##### (a) According to function

- (i) "Time" - to function after a predetermined time; these are subdivided into "mechanical" and "combustion" according to the method of operation.
- (ii) "Proximity" - to function on nearing the target.
- (iii) "Percussion graze" - to function on appreciable deceleration.
- (iv) "Percussion direct action" - to function on impact.

##### (b) According to position in the projectile

- (i) "Nose" - shaped to conform to the shell contour at the nose.
- (ii) "Base" - cylindrical in shape, for entry into the base of the shell cavity.

Nose fuzes have a right-hand and base fuzes a left-hand screw thread, to avoid the possibility of their becoming unscrewed by rotational acceleration in the bore. An exception to this rule is provided by nose fuzes in 2 inch mortars and bomb throwers. Here, rotational effects are negligible, and the use of a left-hand thread prevents the fuze from being unscrewed with the protecting cap (which has a right-hand thread).

##### (c) According to filling

- (i) "Igniferous" fuzes have a magazine filled with gunpowder, to give a flash: these fuzes are not usually employed in H.E. shell unless the filling is provided with a picric powder exploder.
- (ii) "Detonating" fuzes have a magazine filled with a pellet of C.E. A small channel, filled with lightly stemmed C.E., connects from the detonator to the magazine, so that when the detonator is fired, this continuous column of explosive builds up a detonating impulse.

Although particular types of fuzes are considered separately, one or more types may be combined into a single fuze, e.g. "time and percussion", "direct action and graze", etc.

##### FORCES

238. All components of fuzes are either fixed relatively to the fuze or are free to move within certain limits. The movement of the free components, controlled or restrained as necessary by friction and/or springs, depends principally upon the forces arising from acceleration, deceleration and spin, although it is also affected by "side-slap" to an extent depending mainly upon the state of wear of the guns.

Some or all of these forces are utilised to ensure correct operation as well as in various safety devices.

239. Nose Fuzes - The direct action type are normally "armed" by:-

- (a) Set-back force or
- (b) Centrifugal force or
- (c) A combination of both.

Set back force acts on the free or movable parts of the fuze at the instant of firing. Centrifugal force is intended to be effective only when deceleration occurs on the projectile leaving the bore, when the free or moving parts are forced outwards by spin. While passing through the bore the moving parts are expected to remain in their original positions by friction as a result of set-back.

The majority of fuzes incorporate shutters which move into the "armed" position by the influence of centrifugal force. Such shutters are usually designed to remain in the "unarmed" or safe position until the shell is spinning between a specific number of revolutions per minute (r.p.m.) the number of revolutions varying in different fuzes to meet the requirements of the equipments, for which they are approved. Springs assembled either under compression or expansion may be used to assist or restrain the centrifugal force.

Locking devices may also be incorporated to secure the movable components in the armed position after centrifugal force becomes effective.

In certain new fuzes a delayed arming shutter actuated by centrifugal force is incorporated in the design. See para. 247(c).

The "time" element of time (combustion and mechanical) fuzes and in some instances the "self-destruction" element, is initiated at the instant of firing by set-back (that is, the effect of inertia).

240. Base fuzes - The direct action type are normally "armed" in a manner similar to that described above.

A "delay" action, which becomes effective after impact, may be incorporated. Later designs may incorporate a delayed arming mechanism.

241. Acceleration and deceleration - The acceleration of the projectile and fixed components tends to leave the free moving components behind. If the acceleration is moderate, the loose parts "creep back" or if violent, "set-back". Conversely, deceleration causes "creep forward" or "set forward".

Violent acceleration occurs at the instant of firing the gun, and comparatively moderate acceleration with the subsequent forcing of the projectile along the bore of the gun. Moderate deceleration continues from the moment the projectile leaves the muzzle until it becomes violent on impact. Violent and momentary deceleration also occurs with a worn gun with appreciable free run-up when the driving band first takes up the rifling.

242. Spin - Centrifugal force, resulting from the rotation of the shell, acts in a plane at right angles to the line of flight to force the free components outwards from the centre of the fuze.

Centrifugal force is not normally intended to be effective until the shell has left the bore of the gun as the free components are expected to be held in their original positions by frictional forces proportioned to the set-back forces in the gun.

243. Side-slap - Forces acting in a plane roughly at right angles to the axis of the bore are also set up owing to inadequate centring of the projectile. This causes the shoulder of the projectile to hit against the bore of the gun.

These forces, however, are only appreciable with a well worn gun, and in this case the excessive hammering, is known as "side-slap". With the more modern high velocity guns this tendency is restricted if not eliminated by the fitting of double driving bands to the projectile.

#### MECHANICAL DEVICES

244. General - All fuzes embody devices to ensure:-

- Safety in handling, both before and during loading.
- Bore and muzzle safety immediately after firing.
- Arming after leaving the muzzle.
- Firing of fuze magazine and initiation of the bursting charge in the shell.

The above devices are housed in the fuze body. For time fuzes, the fuze body also contains the time element, for proximity fuzes, the proximity element, and for self-destruction, the self-destruction element.

245. Arming of the fuze - This is a mechanical event which is designed to take place as the shell is fired (i.e. time fuzes) or after the shell leaves the muzzle of the gun (i.e. percussion fuzes). Before the fuze is "armed" it should not be capable of being put into operation by any conceivable rough usage, or by any drop in any position which is likely to occur in the Service. Generally speaking, the moving parts of a fuze are securely locked together by a number of devices, and the particular combination of forces which the fuze undergoes when being projected from a gun is used to unlock them. Any other combination of forces would not have the required effect. It is in fact a form of combination lock in which firing from a rifled weapon is the key.

The ultimate object of the mechanical devices is to ensure that the detonator is struck at the desired instant. Premature action is prevented by various forms of holding and locking devices,



and, as a further safety measure, masking devices can be incorporated to block the detonating train to an H.E. bursting charge.

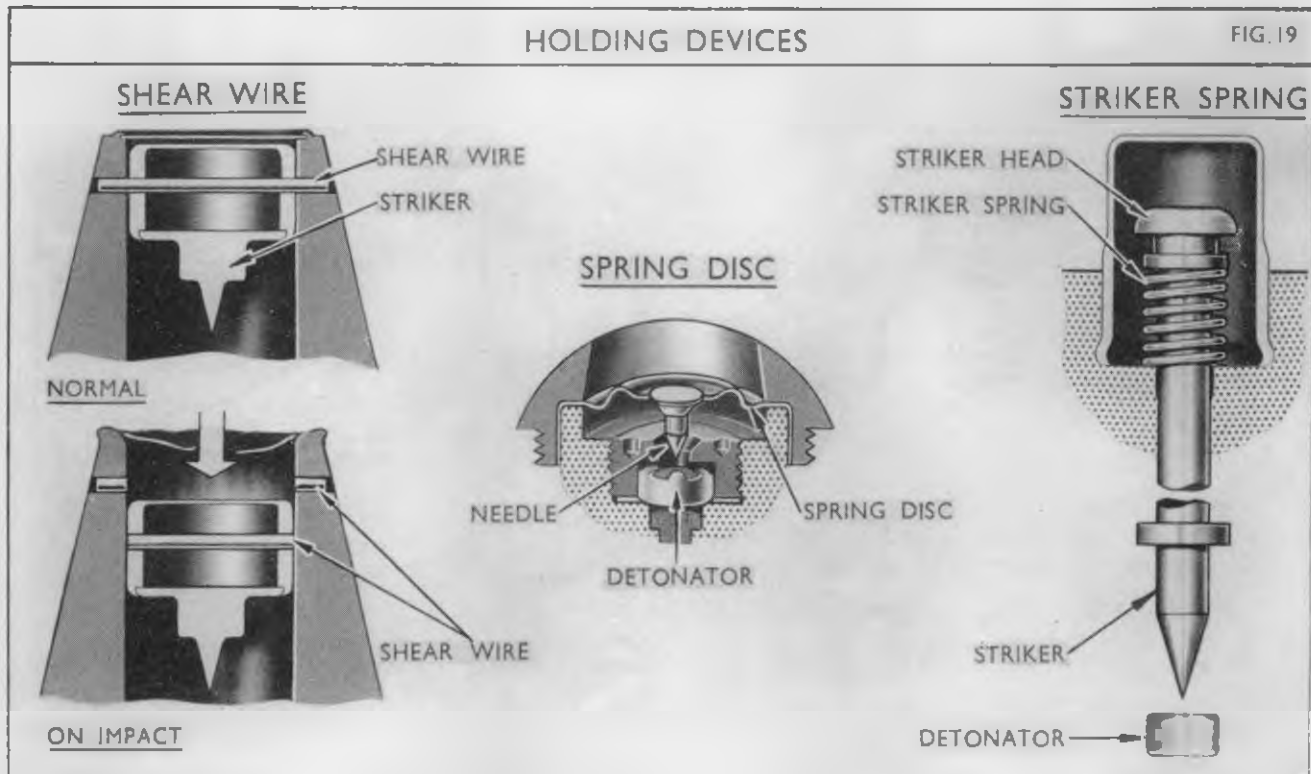
A component is said to be "armed" when it is in such a condition that there is nothing to prevent initiation of the bursting charge, either on a disturbance of the existing state of motion or rest (e.g. impact of a percussion fuse or movement of a blind) or on the functioning (normally or prematurely) of a time device.

Although freedom from premature action is essential for both safety and operational reasons and embraces handling, loading and projection until well clear of the muzzle, the projectile must be fully armed on approaching the target.

The various devices in use are described according to their principal functions of holding, masking and firing, bearing in mind the forces used to operate them as previously described.

246. Holding devices

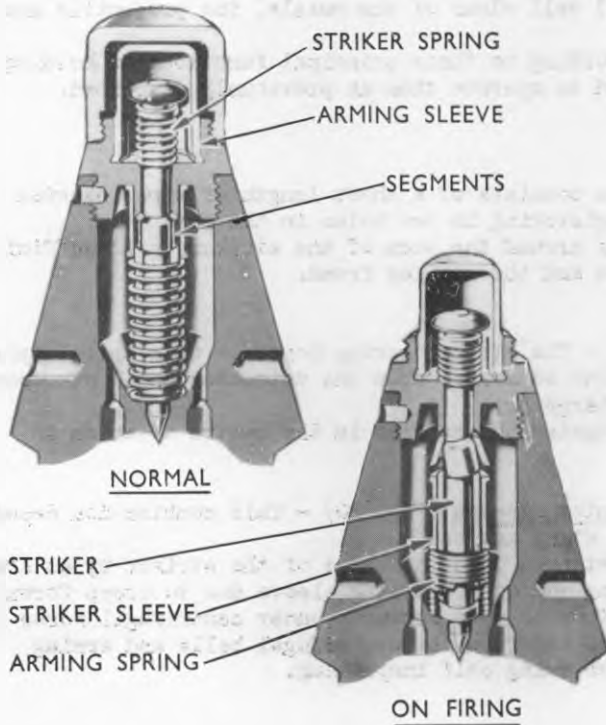
- (a) Shear wire (Fig. 19) - This simple device consists of a short length of wire inserted in a radial hole in the striker the ends registering in two holes in the fuse head, alternatively the ends may be turned over around the stem of the striker. If sufficient force is applied the wire will be sheared and the striker freed.
- (b) Striker spring and spring disc (Fig. 19) - The striker spring consists of a spiral spring surrounding the striker to keep the striker separated from the detonator until overcome by a superior force (e.g., impact with the target). The same function is performed by a corrugated spring disc in the centre of which is fixed a needle.
- (c) Centrifugal balls, segments, etc. and arming sleeves (Fig. 20) - This combination depends for operation on two forces operating at right angles. A number of balls, segments, etc., are retained under a flange of the striker by an arming sleeve. Movement of the detent on firing and of the arming sleeve due to creep forward, uncovers the balls, etc. which are then free to move outwards under centrifugal force to free the striker. In the case of the No. 410 fuse the centrifugal balls and arming sleeve assembly has the added advantage of being self inspecting.



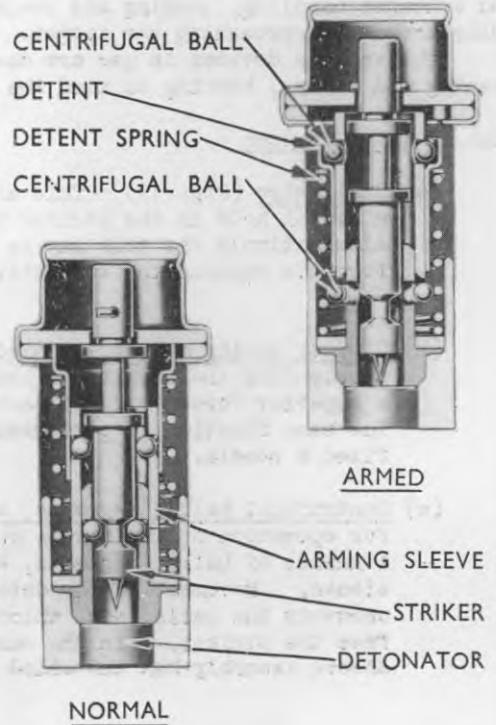
HOLDING DEVICES

FIG. 20

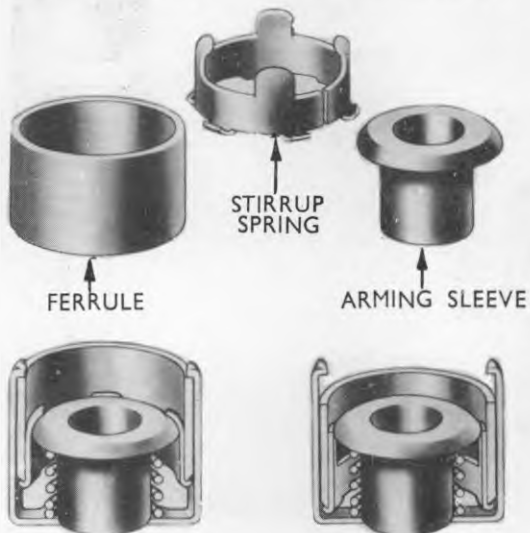
SEGMENTS



CENTRIFUGAL BALLS



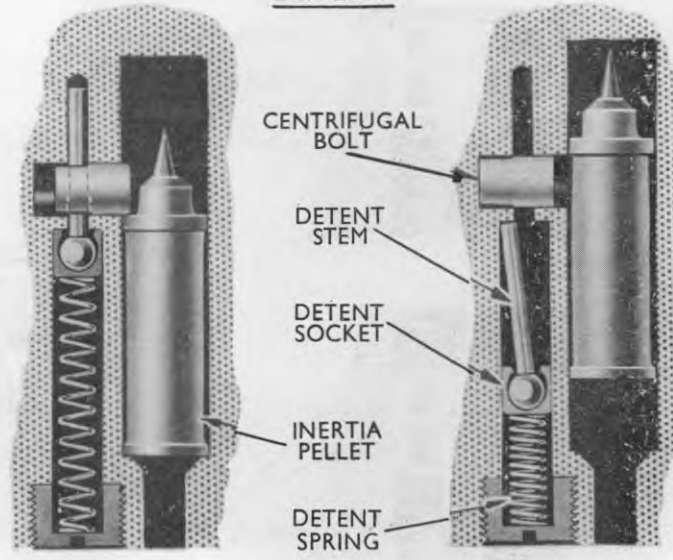
STIRRUP SPRING AND FERRULE



NORMAL

ON FIRING

DETENT



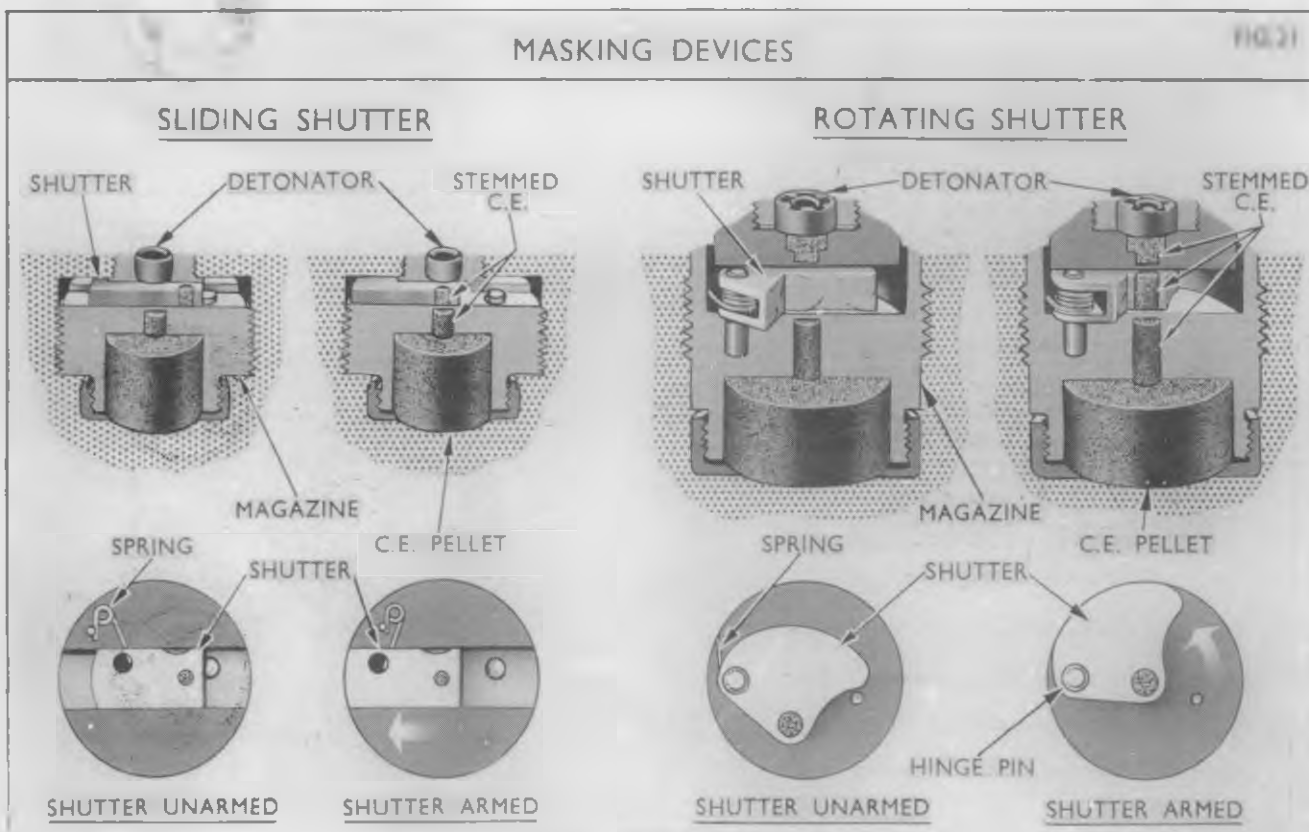
DETENT ENGAGED

DETENT DISENGAGED

- (d) Stirrup spring (Fig. 20) - This consists of a thin metal cylinder with lugs turned over at each end and in opposite directions. The lugs can be used to lock two concentric sleeves together and rest at opposite ends of each sleeve. One of the sleeves is fixed and the other kept against a lug by a spring. The lugs are designed to be straightened out by one of the forces described (paras. 238 to 242) and thus allow the moving sleeve to be freed under action of the spring.
- (e) Ferrule (Fig. 20) - This is simply a sleeve or collar and is usually used to denote the outer or holding sleeve used in conjunction with a stirrup spring to hold the moving (e.g. arming) sleeve or ring.
- (f) Detent (Fig. 20) - This is a form of plunger, consisting of a small metal cylinder or block working in a hole or recess usually in the fuze body and resting on a spiral spring under part compression. The spring is used to keep the detent in a safe position in or behind a moving component and thus lock it. The detent spring may be designed to be overcome by any of the forces described (paras. 238 to 242) to permit the detent being withdrawn and thus unlock or free the moving part.

247. Masking devices

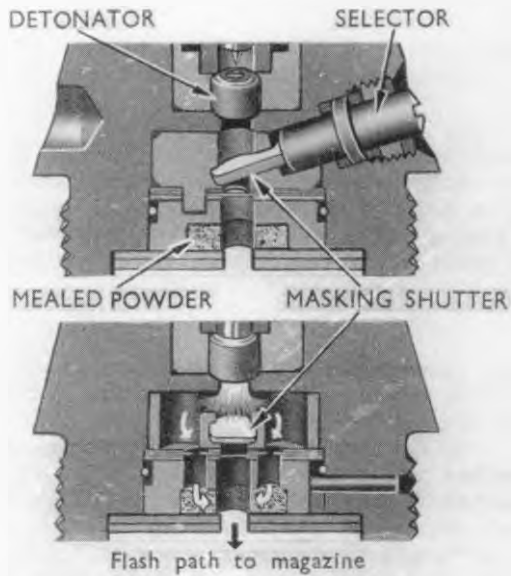
- (a) General In the open or armed position, the detonator is connected to the magazine by channels in the shutter and top portion of the magazine body. In some cases, the striker and detonator are above the shutter and the shutter channels are filled with C.E. In other cases, the striker only is above the shutter, the detonator being housed in the shutter and therefore only positioned under the striker in the armed position. Shutters are so designed that a solid part of the shutter when in the unarmed position is interposed between the detonator and magazine. They are kept in the unarmed or closed position by a spring, either operating directly or through an interlocking device. The shutter moves to the armed or open position under centrifugal force. During the passage of the shell up the bore of the gun, centrifugal force has also to overcome friction between the shutter and platform of the fuze body due to set-back of the former, and, under ideal conditions, this may be sufficient to prevent the shutter arming until the shell leaves the muzzle.



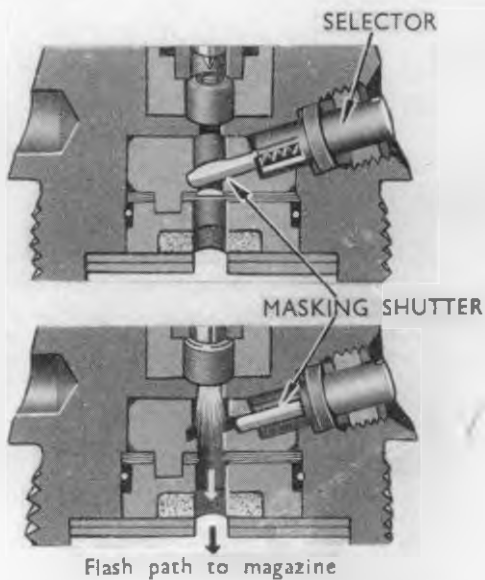
### MASKING DEVICES

FIG. 22

#### DELAY OR NON-DELAY MASKING SHUTTER

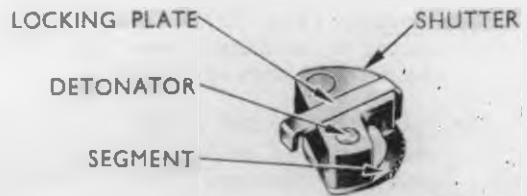


Top view shows selector at DELAY setting. Lower view (section turned 90°) shows flash path on impact.

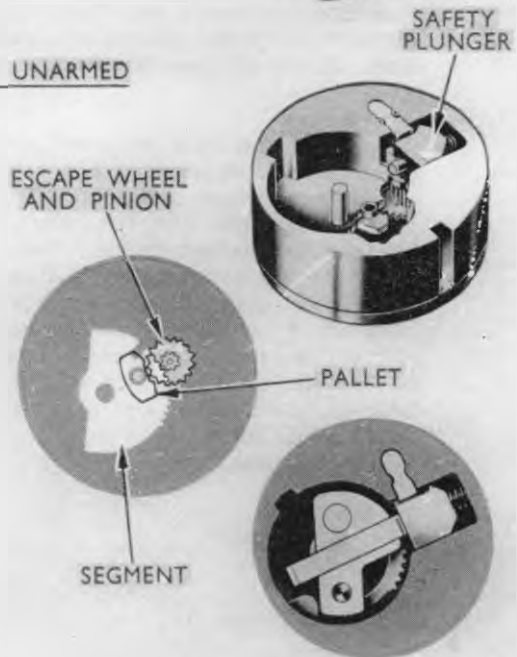


Top view shows selector at SUPER QUICK setting. Lower view shows masking shutter moved outwards by centrifugal force during flight also the flash path on impact

#### DELAYED ARMING SHUTTER



#### NORMAL UNARMED



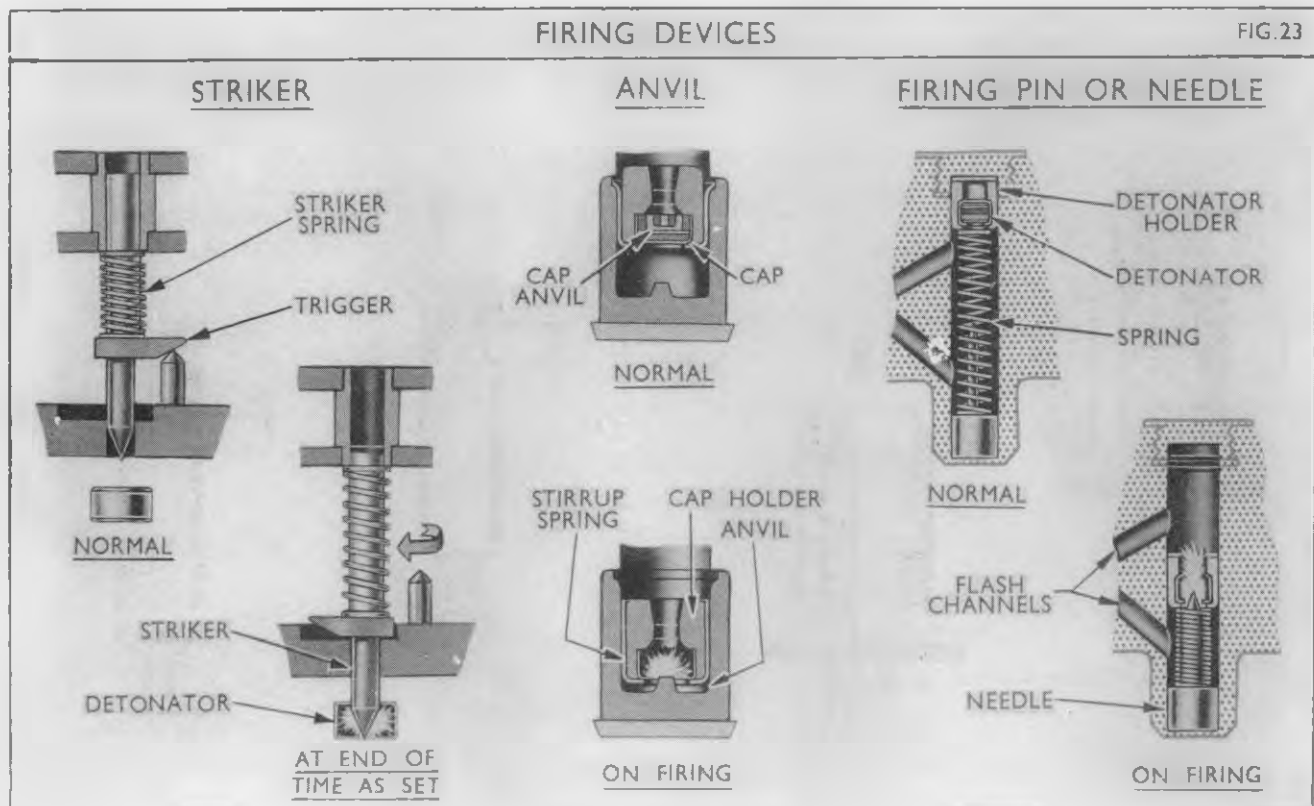
#### DURING FLIGHT



- (b) Non-delay arming or masking shutters (Figs. 21 and 22) - These consist essentially of sliding or rotating blocks of metal, which, in the shut or safe position block the channel leading to the magazine to provide safety from premature firing. In some cases it may take the form of an interrupter (or baffle) which masks the flash channel and is controlled by an optional selector which is set prior to loading.
- (c) Delayed arming shutter (Fig. 22) - This consists of a rotary type shutter containing a detonator assembled in a circular shaped shutter housing. The shutter is held in the "unarmed" position by means of a spring-loaded safety plunger which engages in a locking plate. On spin, the safety plunger disengages by centrifugal force and the shutter then rotates until the detonator is in a central position over the striker hole. The locking plate, which fits into a slot made across the face of the shutter, moves out and engages in a recess made in the outer side of the shutter housing, thus locking the shutter in the open position. The delay is obtained by means of a pallet and pinion mechanism positioned beneath the shutter and this oscillates a segment by means of an escape wheel and pinion which retards the opening of the shutter.

248. Firing devices

- (a) Striker, firing pin or needle and anvil (Fig. 23) - A striker, firing pin or needle is a rod of metal with a pointed end to impinge on the detonator. The American term "firing pin" is synonymous with "striker" and the distinction between a striker and needle is that of size only, the needle being smaller. An anvil is a steel block with a nipple or boss projecting from the centre. Initiation of a detonator is by impact with a striker or anvil nipple. The striker may be forced on to the detonator or the detonator (in a weighted holder or "pellet") on to a striker or anvil. Striker and detonator are kept apart by a holding device. Additional and interlocking devices can also be incorporated.
- (b) Striker spring (Fig. 23) - The striker spring consists of a spiral spring surrounding the striker and is used to drive the striker down on to the detonator when released by a trigger. The spring is kept in compression until released and must not be confused with the striker spring used as a holding device (see para. 246b).



(c) Hammer (Fig. 24) - This is usually a rod with enlarged head and is mounted in front of the striker and used to "hammer" the striker on to the detonator.

The hammer is often used with very sensitive fuzes designed to function on striking on aircraft fabric or skin.

The sensitivity of the fuze can be reduced by having a thin diaphragm formed in the fuze head above the hammer. The shape of the hammer head and thickness of the diaphragm is somewhat critical. If such a fuze is too sensitive it may function on impact with raindrops.

In some cases, the hammer and striker are combined in one piece and the combined hammer and striker is then termed a "hammer".

(d) Inertia pellet (Fig. 24) - This is a metal weight, usually cylindrical in shape and can be used to house a detonator and carry it on to a striker or anvil. Alternatively, it can be fitted with a striker, in which case the pellet moves forward to impinge on the fixed detonator.

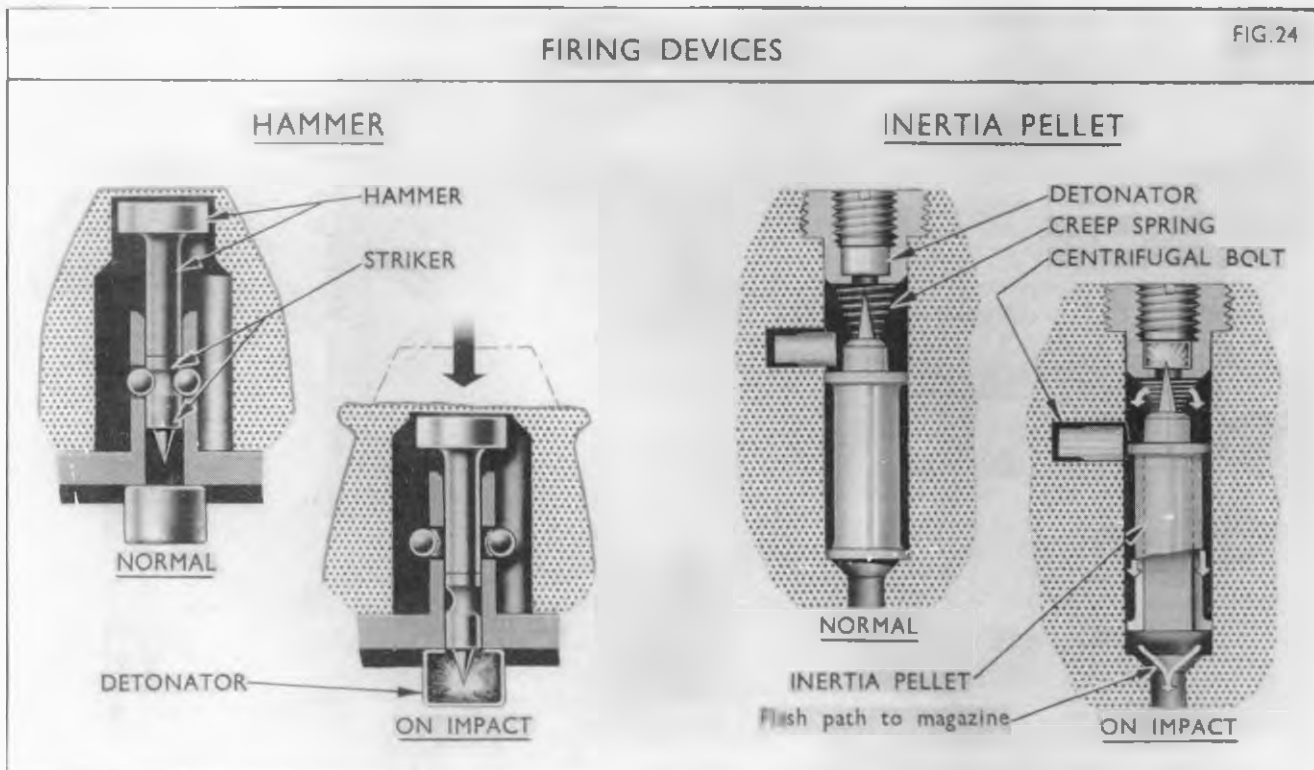
OTHER FUZE COMPONENTS

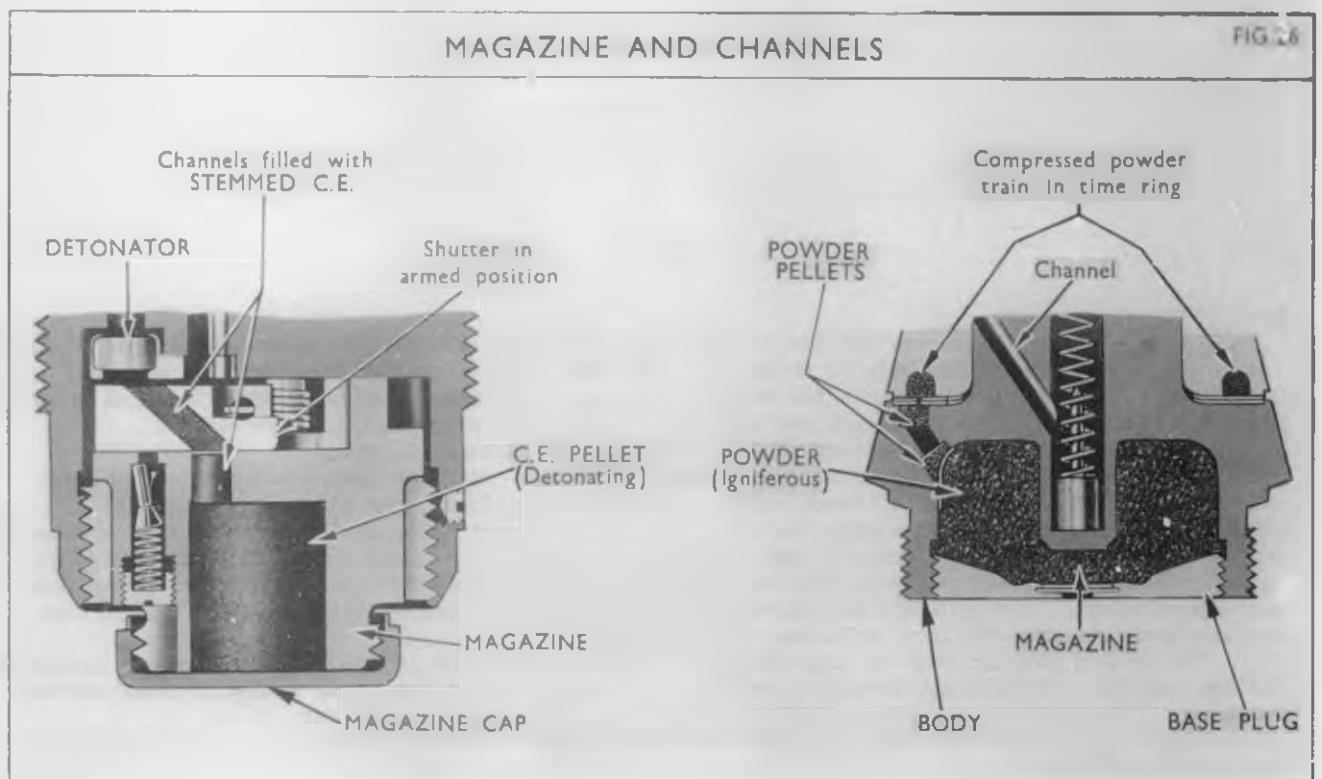
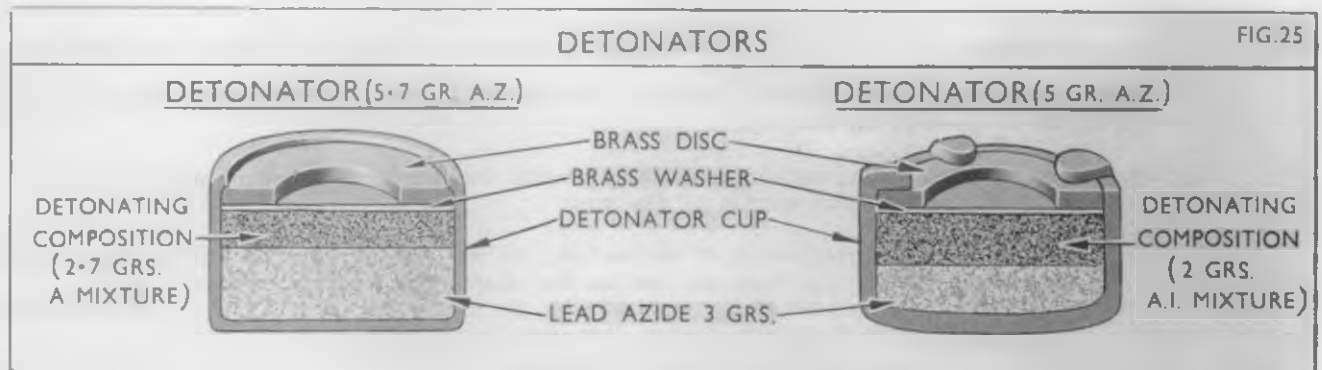
249. Pellets - These are formed of pre-pressed explosive, both C.E. and gunpowder pellets being used. Powder pellets are sometimes perforated, in which case they serve to reinforce flash, or they may be solid and in this form constitute a delay.

250. Detonators (Fig. 25) - These are either igniferous or disruptive according to whether they are required to ignite powder or detonate C.E. respectively.

Detonators consist of small copper cups or shells containing the explosive, closed by a thin metal disc and a brass washer secured usually by turning over the lip or lugs formed on the mouth of the cup. In more recent designs of fuzes, lugless detonators may be assembled therein. Certain detonator cups are tinned whilst others may be made of aluminium.

Detonators are normally initiated by the needle point of the striker piercing the detonator i.e. by friction, but occasions occur where they may be initiated by a flash from another source, e.g. a powder pellet or another detonator. Caps (in the case of primers and tracer igniters) on the other hand are initiated by the rounded end of a striker being driven on to the base of the cap and causing the composition to be "nipped" between two metal surfaces, i.e. the base of the cap and rounded end or boss of an anvil.





251. Magazine (Fig. 26) - This can be formed either in the body of the fuze, or can be a separate container secured in or to the body.

It may be either igniferous or detonating according to whether it is filled with powder to produce a flash or with C.E. to detonate an H.E. charge.

252. Channels (Fig. 26) - These connecting links may contain loose powder, compressed powder, pellets of powder or C.E., or may be empty and merely serve the purpose of flash direction.

Channels filled C.E. or similar high explosive are used to ensure substantial continuity of the detonating train.

253. Caps - These may be of two kinds, an inner one (normally known as a striker cover) to protect and prevent interference with the head of the striker, to act as a windshield and also to prevent moisture, grit, etc. entering the nose of the fuze. This is not removable. The other is an outer or "safety cap" designed to protect the nose of the fuze in transit and handling but intended to be removed at the time of loading the projectile in the gun.

254. Delay systems

Delay in fuzes may be fixed or optional and is attained in three ways:-

- (a) by interposing a baffle in a flash channel to force the flash to follow a tortuous path.
- (b) by interposing a layer of solid pyrotechnic material which must be burnt through to allow the flash to proceed on its way.
- (c) by incorporating a delay mechanism which prevents shutter from becoming armed until the projectile is clear of the muzzle of the gun.

Having regard to the characteristics of detonation, it will be evident that delay can only be obtained in the igniferous train of a fuze and not in the disruptive train. Consequently a disruptive fuze can normally only have delay incorporated if the early part of the explosive train is igniferous. An exception to this rule occurs, however, in detonating fuzes fitted with a delayed arming shutter. (i.e., fuze, perc. base medium L.15). Systems (a) and (b) above may also be employed together.

## Chapter 6 Fuzes

### Section 2. Types

#### TIME FUZES

255. General - Time fuzes are set for time before loading by rotation of a moving portion of the fuze against the fixed fuze body by means of a fuze key, fuze setter or fuze setting machine. Graduations are provided to enable the setting to be set by hand. In some latter designs, however, the graduations are omitted because the fuzes are always set by mechanical fuze setter.

The time element may be either of the combustion or mechanical type.

The bottom portion of the fuze body generally forms a platform upon which the moving part rotates for setting the time of functioning. With British fuzes, the fixed part is either graduated in arbitrary fuze lengths for reading against an indicator on the moving part, or else the moving portion is made to operate a fuze length indicator on the fixed part. In addition, both fixed and moving parts have slots for the engagement by the pawls of fuze keys or the older fuze setting machines. These slots are also used for setting the fuze at "SAFE". The latest fuze setting machines grip the fuze by means of knife rings.

The moving portion must be tight enough to prevent movement in handling, transport, loading and firing, and yet sufficiently loose to permit setting by the fuze key, fuze setter or fuze setting machine. The maintenance of the correct stiffness or tension is important.

"Time" refers to the length of time from the instant of firing the weapon to the instant of functioning of the fuze.

- (a) Mechanical - This type of fuze normally has a fully wound-up clock-work mechanism retained by a trigger, which is released by the "set-back" on acceleration, after which the mechanism works until the movement of its parts releases a striker which is driven on to the detonator by a spring. The time between the starting of the mechanism and the release of the striker can be varied by the "setting" of the fuze. In modern designs a direct action percussion head may also be fitted. In certain fuzes, however, the time mechanism may be functioned by centrifugal force.
- (b) Combustion - In the combustion type of fuze the detonator, in a suitable holder, is supported on a stirrup or coiled spring sufficiently weak to allow the holder to "set-back" on acceleration, bringing the detonator on to a needle. The resultant flash ignites a gunpowder pellet which, in turn, ignites the composition in the time ring(s). These fuzes embody a train of compressed powder which burns through until the time as set has expired. The flash then fires a magazine. The powder is generally contained in circumferential grooves in adjacent time rings, the powder burning in one ring until it can ignite the powder in the other, depending upon the relative position of the two rings as determined by the setting. Two rings are usually employed, the upper ring being fixed by pinning to the stem of the fuze body, and the other movable, or "free" to rotate on the stem. The under surface of both rings is grooved for almost the entire circumference, the grooves being charged with fuze powder under compression.



The upper ring has a radial channel from one end of the powder groove to pick up the flash from the detonator, the channel containing a perforated powder pellet to facilitate this function. A second channel to the outside of the ring forms a gas escape, being fitted with a small closing disc to provide a watertight cover, and a perforated powder pellet to blow the disc clear when ignited.

The lower ring differs only in having a vertical channel (instead of a radial channel) to pick up the flame from the powder grooves in the upper ring.

The central stem or body contains the detonator, needle and magazine.

Cloth washers are placed below the two rings to ensure a tight joint.

Both rings are secured by a cap which is screwed on to the stem of the fuze and bears down on to the rings to secure the necessary tension.

#### TIME AND PERCUSSION FUZES

256. These are time fuzes in which a percussion mechanism is embodied.

#### PERCUSSION FUZES

257. General - Percussion fuzes are of various types according to the speed of action required. Generally speaking, the direct action fuze has the fastest action, followed closely by the graze fuze and finally by the delay action graze fuze.

The essential elements of percussion fuzes are the firing mechanism accompanied by the holding and safety devices. These have already been described in detail in para. 246.

A self-destruction device is necessary for shell fitted with percussion fuzes, when used in the A.A. role, to prevent functioning of the fuze on impact with the ground should the target be missed. Such a device may be embodied in the fuze as a time element.

The term "delay" when used in conjunction with percussion fuzes refers to the action at the instant of impact.

- (a) Direct action (D.A.) fuzes - These fuzes may be of the igniferous or detonating types, the mechanism consisting of a needle supported on a thin metal disc, or a hammer or striker supported on a shearing wire or coiled spring, exposed to a direct blow on impact with the target; its sensitivity depending on the strength of disc, shearing wire or coiled spring. It may be provided with a safety pin or tape, arming sleeve and segments retaining the striker in a safe position, and also usually a shutter. D.A. fuzes filled C.E. are instantaneous in their action while D.A. fuzes filled gunpowder have a slight delayed action.
- (b) Direct action impact (D.A.I.) fuzes - These fuzes may be of the igniferous or detonating types, they differ mainly from the D.A. in being less sensitive. The mechanism usually consists of a steel hammer supported on a stout shearing pin; a shutter is also usually embodied.
- (c) Graze fuzes - The interior mechanism of graze fuzes is so arranged that when the shell is checked in flight or receives an appreciable deceleration, a movable part, usually called the graze, or inertia pellet can move forward to carry the detonator on to the needle (or vice versa).  
A creep spring keeps the two apart until this deceleration is experienced.  
As the movement of the inertia pellet or weighted needle gives rise to an "air gap" the fuze detonator is of the flash type.  
Graze fuzes have a small inherent delay.

#### BASE FUZES

258. These fuzes usually depend on a detonator in an inertia pellet being driven on to a fixed needle (or vice versa) by the sudden retarding of the projectile at the moment of impact. A delay may be incorporated. Later designs may incorporate a delayed arming mechanism.

#### PROXIMITY OR VARIABLE TIME (V.T.) FUZES

259. These are automatic time fuzes that require no accurate time setting. They are designed to detonate the shell at the optimum lethal distance from the target, provided that, in the case of A.A. targets, the trajectory passes sufficiently close. The present day artillery V.T. fuze in Service use is essentially a combined self-powered radio transmitting and receiving unit. In flight, the armed fuze transmits radio waves. Unlike radar devices, the waves are sent continuously and are non-directional. The radio wave fronts which are reflected back to the fuze, from any suitable reflecting surface (e.g., the ground or air targets), interact with the transmitted waves. When this inter-action of transmitted and reflected waves, resulting in ripples or beats, reaches a predetermined intensity, an electronic switch is tripped which then permits an electric charge in the firing capacitor (condenser) to flow through an electric firing squib, detonating the filling in the projectile.

The major differences between the different types of V.T. fuzes are in the matching of the radio to the shell, in optimising the sensitivity to the target (ground or air), in the arming delay and the self destruction features.

Safety devices are included as for other types of fuzes. These may be either electrical or mechanical. The fuzes are completely bore and muzzle safe.

FUTURE DESIGNATION AND MARKING

260. Fuzes of new design will, in future irrespective of their size or classification, be marked and introduced by a model number, e.g. L1, followed by the letter A and a number, i.e., L3A1, instead of a serial number and mark as formerly used for identification. New patterns of existing fuzes, will, however, continue to be introduced and identified by an advance of the mark.

## Chapter 6

### Fuzes

#### Section 3. Fuzing Procedure

GENERAL

261. The operation of fuzing and re-fuzing projectiles requires careful supervision and should be undertaken under conditions approaching as closely as possible to "field laboratory conditions" as defined by Regulations for the Army Ordnance Services, Part 6, Supply of Ammunition in the Field, paras. 120 to 139 inclusive. In particular, the operation will be carried out under cover, no fires, naked lights, lighters, matches or smoking materials being allowed in the vicinity.

The atmospheric conditions of the hut or tent in which the operations of opening up and closing the shell are carried out must be quite dry to prevent moisture entering the shell when opened up.

All components must be perfectly dry before insertion, and only one shell at a time must be worked upon during breaking down and assembly. All operations must be carried out "under precautions".

In all shell operations, cleanliness and careful handling are most important and it is essential that no dirt, dust, grit or extraneous matter be allowed to enter the shell, or come in contact with any components. Before the removal of any components, therefore, the exterior of the shell must be thoroughly cleaned and the components stored in perfectly clean packages until required again.

To sum up, therefore, although fuzing is normally a laboratory job, if the three basic principles of

DRYNESS                      CLEANLINESS                      CARE

are observed, it can be carried out by battery personnel in a satisfactory manner.

262. Tools required - The correct implements should invariably be used in order to minimize damage to ammunition and danger to personnel. The following tools should be available:-

TOOL	USE
Key, ammunition - No. 53 or 121	for inserting or removing 2 inch perc. fuzes for H.E., smoke and powder filled shell.
No. 119	for inserting or removing fuzes, perc. D.A. No. 162 fuze, T. & P. graze No. 221B.
No. 222	for inserting or removing plug, fuze-hole, No. 29
No. 224	for inserting or removing fuze, time, No. 213.

EXAMINATION OF FUZES

263. Any fuze which appears to have been damaged in any way will be set aside, reported and will not be used for fuzing shell. (See section 4).

Before fuzing shell with fuzes Nos. 117, 119 and 213 the black safety caps of the fuzes will be removed and the striker covers and striker disc, as applicable, examined.

If the striker cover or disc is damaged, perforated, missing or is excessively loose, the fuze will be set aside and reported. Rotation, or slight up and down movement of striker covers is acceptable, but marked up and down movement should not be accepted. A defective striker cover may cause a premature. After examination the safety cap should be replaced.

### H.E. SHELL FUZE - HOLE PLUGS

FIG 27

NOTE:- All plugs are 2 inch 14 T.P.I. and are assembled with leather washers (See inset A)

**A**

YEAR OF MANUFACTURE

INDICATES CAST IRON  
S - STEEL  
M - METAL

PART NUMBER  
MK 4 - SX 13 CAST IRON  
MK 4/1 - SX 222 STEEL  
MK 4/2 - SX 223 METAL

CONTRACTORS INITIALS  
OR RECOGNIZED  
TRADE MARK

LEATHER WASHER  
(USED ON ALL PLUGS)

0.5"

**MARK 4 No.1 2 INCH FUZE - HOLE PLUG**

**C**

ABBREVIATED  
NOMENCLATURE  
OF PLUG

CONTRACTORS INITIALS  
OR RECOGNIZED  
TRADE MARK

YEAR OF MANUFACTURE

4.88"

MK 1 - CAST IRON  
MK 1/1 - STEEL  
MK 1/2 - ZINC  
BASE ALLOY

MODEL NUMBER (STEEL)

**MARK 1 No.29 & L4A1 2 INCH FUZE - HOLE PLUGS**

**B**

ABBREVIATED  
NOMENCLATURE  
OF PLUG

CONTRACTORS INITIALS  
OR RECOGNIZED  
TRADE MARK

**MARK 5F No.3 2 INCH FUZE - HOLE PLUG**

MODEL NUMBER (STEEL)

CONTRACTORS INITIALS  
OR RECOGNIZED  
TRADE MARK

YEAR OF MANUFACTURE

4.88"

**MARK 1 No.29 & L4A1 2 INCH FUZE - HOLE PLUGS**

**D**

ABBREVIATED  
NOMENCLATURE  
OF PLUG

CONTRACTORS INITIALS  
OR RECOGNIZED  
TRADE MARK

YEAR OF MANUFACTURE

1.48"

MK 5 - CAST IRON  
MK 5/1 - METAL  
MK 5/2 - STEEL

CONTRACTORS INITIALS  
OR RECOGNIZED  
TRADE MARK

MODEL NUMBER (STEEL)

YEAR OF MANUFACTURE

**MARK 5 No. 13 & L2A1 2 INCH FUZE - HOLE PLUGS**

The fuze covers of combustion time fuzes should be kept on until immediately before use and not removed when preparing for ready-use. Fuzes with tight covers should preferably be used for ready-use, the covers being tested for looseness by a straight pull only and never by a twisting motion that might disturb the setting.

NATURES OF SHELL NORMALLY ISSUED FUZED OR PLUGGED

264. Base fuzed shell are issued with fuzes assembled, and flare and star shell are normally issued with fuzes assembled. Smoke shell previous to October 1956 were issued with fuzes assembled, but after this date they are issued plugged.

Q.F. 25 pr. H.E. shell are normally issued fuzed, except H.E. shell filled to code L7 (DD(L)18851 and D2(L)554/GF/229) and those issued specifically for use with fuze No. 213.

M.L. 4.2 inch mortar bombs are normally issued fuzed.

B.L. 4.5 inch and 5.5 inch gun and 7.2 inch howr. H.E. shell are issued plugged.

265. Types of plugs used for H.E. shell - H.E. shell may be issued plugged with one of three different types of plug which vary according to the type of filling and method of exploding i.e.:-

(a) Plug No. 3 (Fig. 27B)

A plug with a long shank. The head may be painted or otherwise coloured black or it may be painted the same colour as the basic body colour of the shell.

(b) Plug No. 13 or L2A1 (Fig. 27D)

A plug without a shank. The head is painted or lacquered blue to denote that the top exploder is assembled in position. The No. 13 may be manufactured of steel, case iron or metal and must not be fired. The L2A1 is of steel and may be used in lieu of a fuze when the gun is required to be zeroed.

(c) Plug No. 29 or L4A1 (Fig. 27C)

Shell fitted with this plug have no top exploder and are for use with VT fuzes only.

INSTRUCTIONS FOR FUZING

266. To fuze H.E. shell plugged with No. 13 or L2A1 plugs (Fig. 28,

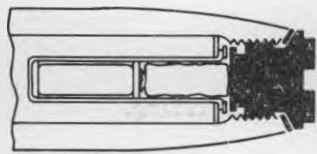
- (a) Remove the plug and leather washer. Shell with plugs set fast should be set aside, no leverage other than the key provided must be used.
- (b) Remove the tracing cloth discs and examine the exposed portion of the top exploder bag to ensure that it is in good condition. If no top exploder is present, insert one as described in para 267 (c) and (d). Replace the tracing cloth discs, with the glazed sides together, on top of the exploder. If only one tracing cloth disc is available, place it with its glazed side next to the exploder.
- (c) Inspect the fuze hole threads and the fuze cavity to ensure that there are no particles of C.E. present. If any particles are found no attempt should be made to fuze the shell, which should be set aside for disposal as described for defective ammunition in para. 286.
- (d) See that the base and screw-threads of the fuze are clean and that the threads are undamaged. The lower threads, except the innermost three, should then be lightly smeared with thin luting, and the upper threads with luting, thick, Mk. 8, a fillet of the latter being placed around the underside of the flange.
- (e) Screw the fuze into the shell, using the correct key. Make certain that the fuze goes right home, no forcing should be necessary. If the fuze body binds against the cavity wall, reject the shell or the fuze according to which is at fault. Do not hammer on the fuze key handle to tighten the fuze. Use only such pressure as can be applied by hand to the fuze key handle. If the fuze cannot be tightened so that a good seating is obtained between the lip of the shell and the flange of the fuze, reject either the shell or the fuze. Wipe off any excess of luting which may exude at the shell/fuze joint.

267. To fuze H.E. shell plugged with No. 3 plugs, for use with percussion or time fuzes (Fig. 28)

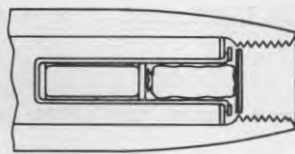
- (a) Remove the plug and leather washer. Shell with plugs set fast should be set aside, no leverage other than the key provided must be used.
- (b) Inspect the fuze-hole threads and the fuze cavity to ensure that there are no particles of C.E. or H.E. filling present. If any particles are found no attempt should be made to fuze the shell, which should be set aside for disposal as described for defective ammunition in para. 286.

H.E. SHELL SUITABLE FOR STANDARD FUZES, PLUGGED WITH  
No.13 (OR L2A1) & No.3 FUZE HOLE PLUGS

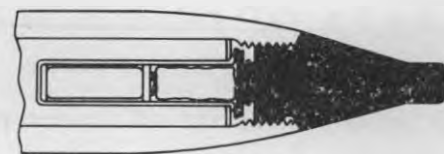
FIG.28



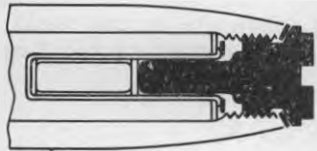
Remove No.13 plug, leather washer, and tracing cloth discs



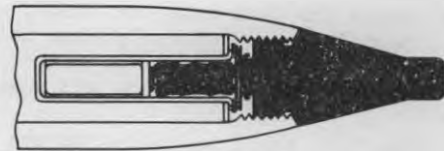
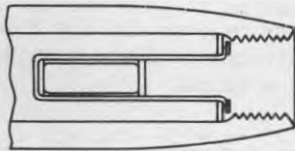
If exploder present replace tracing cloth discs



Apply luting and screw in fuze (see para. 271 for use of washer)



Remove No.3 plug and leather washer



Insert 'B' exploder and tracing cloth discs. Apply luting and screw in fuze (see para. 271 for use of washer)

- (c) Soften a "B" exploder by rolling it between the hands and tuck the choke out of the way. (The choke is usually to blame if the exploder will not fit correctly into its cavity).
- (d) Insert the "B" exploder, choked end downwards, carefully and squarely into the exploder cavity. Press the exploder well home into the cavity by hand and compress it, without any rotary movement, using the thumbs or a smooth headed wooden "pestle" made up locally. Place two tracing cloth discs, with the glazed sides together, on top of the exploder.
- (e) See that the base and screw-threads of the fuze are clean and that the threads are undamaged. The lower threads except the innermost three, should then be lightly smeared with thin luting, and the upper threads with luting thick Mk. 8, a fillet of the latter being placed around the underside of the flange.
- (f) Screw the fuze into the shell, using the correct key. Make certain that the fuze goes right home, no forcing should be necessary. If difficulty is experienced in screwing the fuze completely home this implies that the exploder has not been sufficiently compressed into its cavity and if the exploder is found to have burst, no attempt should be made to fuze the shell, which should be set aside for disposal as described for defective ammunition in para. 286. If the fuze cannot be tightened so that good seating is obtained between the lip of the shell and flange of the fuze, reject either the shell or fuze. Wipe off any excess of luting which may exude at the shell/fuze joint.

268. H.E. shell suitable for use with VT fuzes

The two types of shell suitable for use with VT fuzes are marked as follows:-

- (a) Those suitable for use with VT fuzes only - Shell of this type will be stencilled with the number of the fuze for which they are designed e.g., "USE FUZE T 100".
- (b) Those suitable for use with VT or with standard fuzes - Shell of this type will be marked with two vertical black stripes, diametrically opposed on the nose, the stripes extending down over the red filling ring. To avoid overpainting the red filling ring may be positioned approx. 1.1/2 inches below the lip of the shell so that the stripes terminate just above them.

Each VT i.e. T97 or T100 fuze is issued sealed in a metal container. There are twelve containers to a box and in each box is a special fuze key. Some fuzes may be issued with a bakelite cover fitted to the base of the fuze in place of the auxiliary detonator, which is then issued separately. This cover must be removed and an auxiliary detonator fitted before the fuze is inserted in the shell. Both cover and auxiliary detonator have left-handed threads.

Shell should not be fuzed with VT fuzes until immediately before they are required to be fired. Shell fuzed with VT fuzes should not be loaded into vehicles. The fuze must be removed and the shell

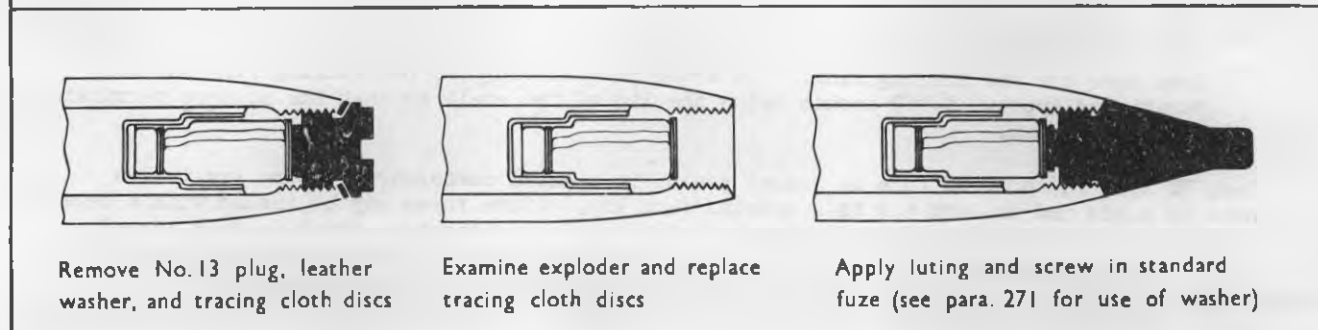
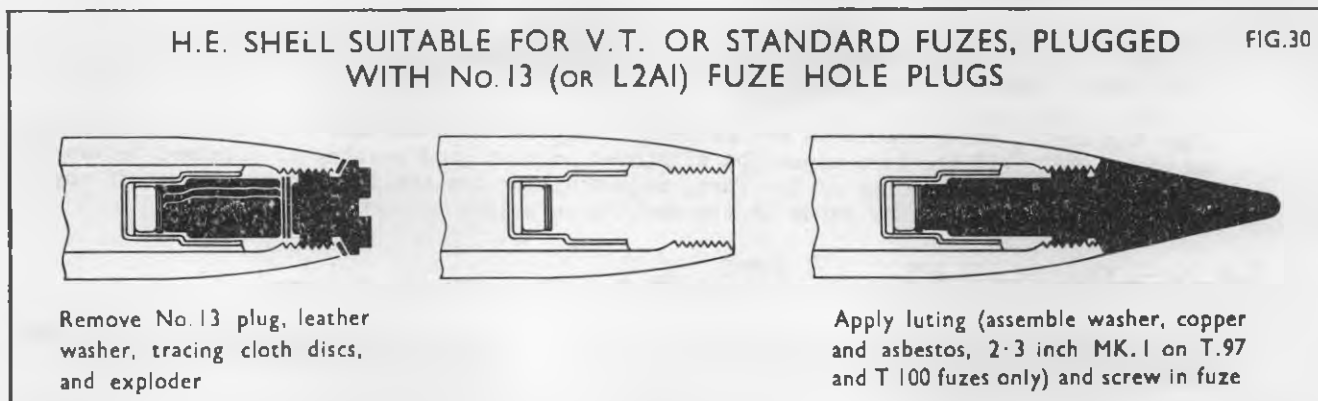
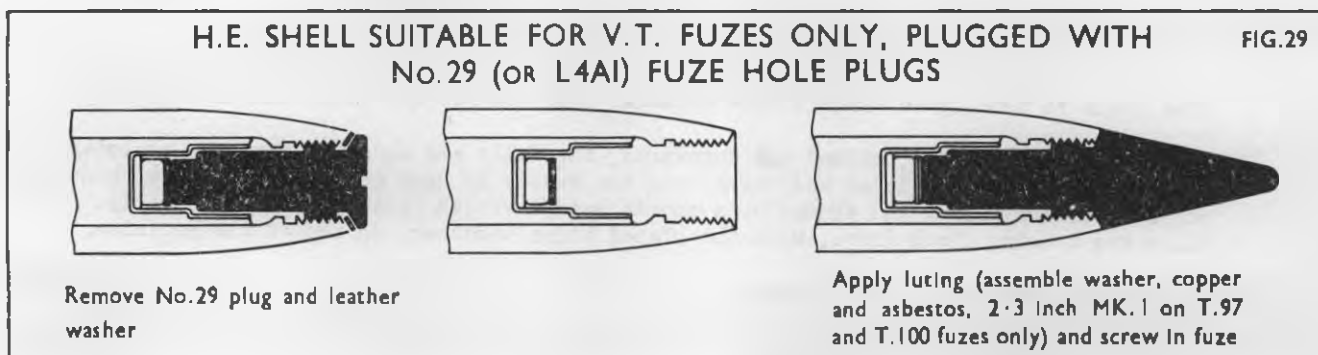
plugged with plug fuze-hole No. 29 or L4A1 for travelling. VT fuzes must be handled with care. No fuze which has been subjected to excessively rough handling should be fired, as it may result in a blind.

269. To fuze H.E. shell suitable for use with VT fuzes only (Fig. 29)

- (a) Remove plug and leather washer.
- (b) Examine the cavity and screw-threads and remove any loose particles of filling.
- (c) Remove the fuze from its container and make sure that an auxiliary detonator is fitted.
- (d) See that the base and screw-threads of the fuze are clean and the threads undamaged, and lightly smear the lower threads with thin luting, and assemble a washer, copper and asbestos, 2.3 inch under the flange of the fuzes.
- (e) Screw the fuze into the shell, and tighten it with the special key provided. If the fuze cannot be screwed fully home it must be removed and the fuze and fuze-hole in the shell examined for damaged threads. Any attempt to force home the fuze by hammering the fuze key may damage the fuze and result in a blind.

270. To fuze H.E. shell suitable for use with VT or with standard fuzes (Fig. 30)

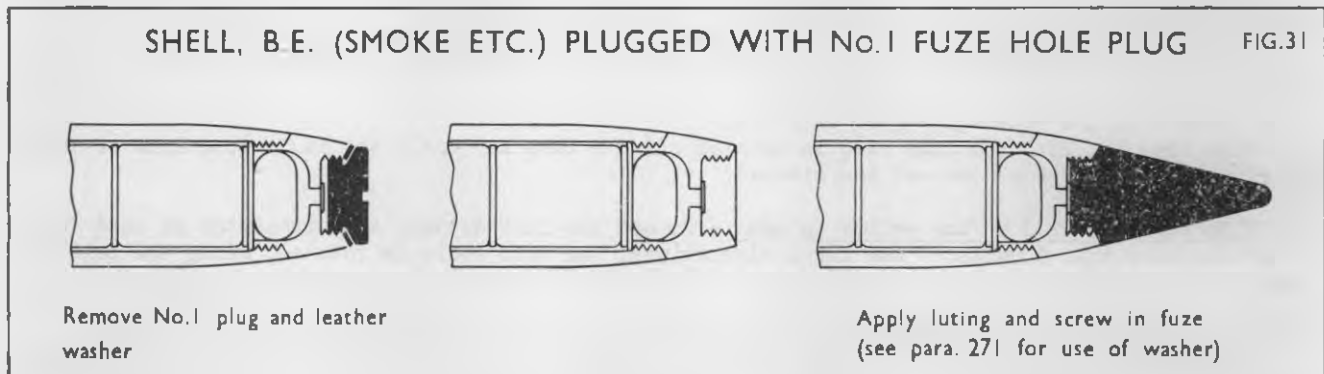
- (a) Remove the standard fuze or the plug and washer. Shell with plugs set fast should be set aside, no leverage other than the key provided must be used.



- (b) In the case of assembly of VT fuzes remove the tracing cloth discs and insert the hook of the special fuze key into the loop on top of the exploder and withdraw the exploder.
- (c) Proceed as in paras. 269 (b) to (e) above in the case of assembly of VT fuzes and paras. 266 (b) to (e) in the case of standard fuzes.

271. To fuze shell with time or time and percussion fuzes (Fig. 31) - Such fuzes are used with B.E. smoke, flare, star and chemical shell. These natures of shell may be issued fuzeed or may be issued plugged with 2 inch No. 1 plugs (see Fig. 27.A).

- (a) Remove the plug and leather washer. Inspect the cavity and fuze-hole threads to see that they are clean, free from loose explosive and undamaged.
- (b) See that the base and screw-threads of the fuze are clean and the threads undamaged, and lightly smear the lower threads with thin luting, apply luting, thick, Mk. 8 to the upper threads and also a fillet around the underside of the flange.
- (c) Screw the fuze completely home using the fuze key provided, taking care not to damage the fuze cover.



272. Washers - use of between lip of shell and flange of fuze - In the case of No.221B marks 1, 2 and 3 fuzes a steel "washer, self-centring, 2.3 inch Mk.1" or a "washer, copper and asbestos, 2.3 inch Mk. 1" must be fitted under the flange of the fuze at the time of insertion into the shell. This is to prevent the band securing the fuze cover being pinched between the lip of the shell and flange of the fuze body thus making the removal of the fuze cover difficult.

Washers are not required for use with fuzes manufactured with a stepped shoulder on the body.

Washers are not used under the flange of fuzes approved for use in H.E. filled shell, except in the case of VT T97 and T100 fuzes where a washer, copper and asbestos, 2.3 inch is required to be assembled.

On no account will leather washers be used nor will any washer which is assembled under the head of a plug be removed and re-used under the flange of a fuze.

#### PREPARATION FOR FIRING

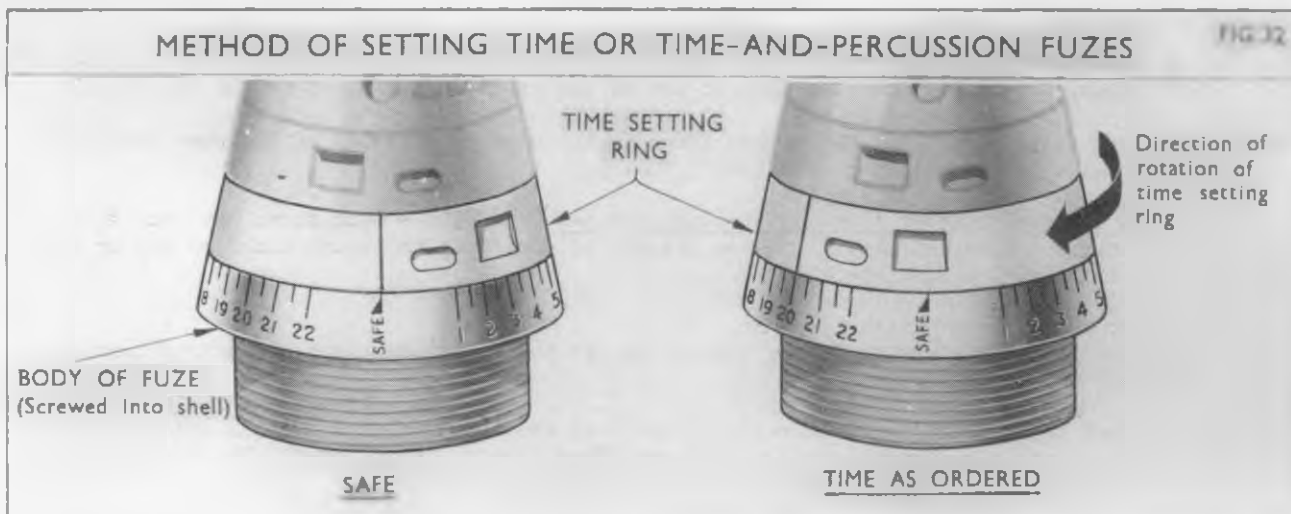
273. The black safety caps of fuzes Nos. 117 and 213 must always be removed before firing. The black safety cap of fuze No. 119 must be removed before firing unless the ammunition is ordered to be fired "HE 119 cap on".

In the case of B.L. ammunition the safety caps of fuzes will not be removed until the shell is on the loading tray and in the case of Q.F. separate loading ammunition only just prior to the shell being loaded.

The fuze covers of combustion time fuzes should not be removed until immediately before they are required for use.

274. VT fuzes - Some VT fuzes are issued with a piece of waxed paper fitted over the nose. This paper must be removed before firing. No attempt must be made to remove the normal wax coating of the upper portion of the fuze. Apart from the above, VT fuzes require no other preparation for firing.

275. Time and time and percussion fuzes - Fuze No. 221B will function as a time fuze at any setting between "0" and the highest setting. The setting "0" will burst the fuze at or close to the muzzle. B.E. smoke shell may be fired at fuze set "0".



Fuze No. 213 incorporates a safety device which prevents the fuze functioning as a time fuze at settings lower than 1.6.

In setting fuzes Nos. 213 and 221B, the movement will be one of decreasing the fuze setting i.e. a clockwise movement tending to tighten the fuze in the shell. The only exception to this rule is that a small increase in setting may be made when required, provided the final movement is a clockwise one of decreasing the setting. (See Fig. 32).

With fuze No. 221B the time ring is rotated using a fuze key until the indicating line of the time ring is opposite the fuze setting ordered.

276. With fuzes No. 213 a fuze setter is used - To set the fuze setter, the micrometer is used for alterations less than 5 units. For large alterations, the main scale is rotated, using the quick-release, to a position within one or two units of the setting ordered. The gears are then re-engaged, and the micrometer is turned through at least one complete turn until the main scale is reading the number of units ordered and the micrometer is reading the number of decimal points.

The fuze setter, having been set as ordered is placed over the fuze and turned clockwise until it engages. It is then turned anti-clockwise for about one eighth of a turn i.e. until its motion is stopped by the plunger engaging in the fixed slot and finally turned clockwise until no further turning is possible. The fuze is now set, and the setter should be removed, care being taken to ensure that the setting is not disturbed in so doing.

#### TO PREPARE SHELL FOR RETURN TO VEHICLE

277. Fuzed shell - If boxes carrying fuzed shell are available. Fuzed shell will be replaced in the boxes after the fuzes have been re-capped or set to "SAFE" as applicable.

If boxes carrying fuzed shell are not available. Fuzes will be re-capped or set to "SAFE" as applicable and then removed. The "B" exploder will be left in position and the shell will be plugged using No. 13 plugs. The grumets will be replaced. Any shell in which the "B" exploder bag is found to be burst will be set aside for disposal as described for defective ammunition in para. 286.

## Chapter 6

### Fuzes

#### Section 4. Care, Preservation, faulty Ammunition and Prematures

#### CARE OF FUZES

278. The fuze is the most delicate component of a complete round of ammunition and rough treatment and prolonged exposure under adverse weather conditions may cause damage and rapid deterioration, with the consequent risk of a blind or premature. The risk of damage to the fuze is greater when shell are carried fuzed and, therefore, unless "boxes carrying fuzed shell" are available, medium and heavy shell should not be transported fuzed. Any such shell prepared ready for firing must be unfuzed and plugged before being returned to vehicles. With all natures of equipment, every care



should be taken to protect fuzed shell from jarring or from being knocked or jolted against any hard object.

The drill for uncapping fuzes as laid down in the gun drills concerned must be adhered to strictly. When shell are prepared in advance for a programme shoot, the safety caps of fuzes such as Nos. 117, 119 and 213 must be replaced and the shell stacked or re-boxed with the caps on. Fuzing of medium and heavy shell - Lack of care in fuzing shell has been suspected of being at least a contributory cause of prematures in the 5.5 inch gun, the following two possible causes of prematures are the result of this careless fuzing.

Broken exploder bags, with the risk of loose particles of C.E. being trapped between the screw-threads of the shell and the fuze.

Fuzes not screwed fully home with the consequent risk of movement between fuze and shell or of the shell filling at "shot start".

Full details of the precautions to be observed in fuzing shell are given in Section 3 and are also incorporated in the relevant gun drills.

#### PRESERVATION

279. Fuzes deteriorate quickly when exposed to the atmosphere; it is important, therefore, that only such as are required for immediate use should be uncovered or removed from their hermetically sealed cylinders.

All openings in fuzes are treated with composition to prevent the entry of moisture and under normal condition, fuzes should remain waterproof.

Time, and time and percussion fuzes of the combustion type are treated with waterproofing composition over the escape holes in the time rings, set screw recesses and also in the space between the cap, time rings and body. The threads of the base plug are treated with cement.

These fuzes are further protected by metal or tinned-plate covers which form an integral part of the fuze and are secured in position by a band secured by wire or similar means. The covers should never be twisted by hand to ascertain if they are tight, they should only be tested by pulling. When issued separately, fuzes are packed in containers or cylinders which are hermetically sealed. From the foregoing it will be seen that fuzes are adequately protected and should remain serviceable so long as the fuze seal remains unbroken and the container or cylinder in good condition.

The waterproofing of the time ring is broken when a fuze is set, or by loss of tension and unless it is restored at once the fuze may rapidly become unserviceable. The time ring may be moved accidentally by the turning of a loose fuze cover, or by vibration when travelling or the time rings have become loose owing to loss of tension.

Whilst the fuze cover is in position on the shell, it must be assumed that the fuze is serviceable and usually the fuze will be found to be set at SAFE when the cover is removed.

Tensioning is the means by which relative movement between the time rings and the fuze body is prevented and the flame from the composition in the time rings of powder filled fuzes is confined. It also provides a seal against the entry of the flash of any propellant gases that may pass over the shell. Loss of tension may therefore lead to a "flash-over" or a premature in powder train fuzes. Further, if the time rings are loose in powder filled fuzes they may move relative to one another and so alter the setting; thus leading to a blind, a burst out of the calculated position or possibly a premature. Fuzes that have lost their tension, or have loose time rings, must not therefore be used.

Loss of tension with consequent movement of time rings is a defect seldom found, but every effort should be made to detect such defects when fuzes are uncovered. When a fuze is uncovered and found to be set at other than the SAFE position it is a clear indication of loss of tension and it should be replaced as soon as possible. If this cannot be done, it should be set aside for examination by an I.C.O. after it has been re-set at SAFE and had the waterproofing restored.

Except in great emergency, fuzes should not be pre-set unless some means of waterproofing is instantly available. When fuzes have to be pre-set it is imperative that the waterproofing seal, broken by the operation of setting, should be restored immediately the setting of each individual fuze is completed.

All uncovered fuzes, whether set at SAFE or not, should be treated with RD 1154 composition. The composition should be worked by hand into the grooves above and below the movable time ring. Surplus composition must be scraped off with a suitable chisel-shaped tool of wood or non-ferrous metal. None should be left in the setting slots, neither should there be a heavy deposit on the escape-hole discs of the time rings. The surface of the fuze must be left clean with the graduations clearly visible. This operation must be repeated every time the time ring is moved and will be facilitated if the composition is slightly warmed.

This waterproofing procedure will not repair a damp fuze, but it will ensure that a dry fuze remains serviceable.

#### FAULTY AMMUNITION

280. There is evidence to show that, where prematures have occurred by reason of faulty ammunition design or manufacture, certain fuzes have been more prone to prematures than others. Certain types

and marks of fuzes are therefore restricted in their use both for training and operations. This matter is under constant review and Army Council Instructions are issued and amended from time to time to give the latest position. The provisions of these A.C.I.'s must be strictly observed.

#### PREMATURES

281. Most of the evidence is destroyed although circumstantial evidence will be available by taking details of the next round that would have been fired but for the premature. Particulars of the shell burst are most valuable. The nature of the burst, including position, noise, appearance and the colour of the smoke and the presence or absence of strike marks on the ground should be noted. An immediate search should also be made for all shell and fuze fragments. Fragments should be retained for subsequent expert examination and a sketch made to show where they were recovered in relation to the gun.

Evidence of actual fuze setting, bearing and Q.E., are also most valuable and every effort should be made to record even approximate details.

Equipment damaged as a result of a premature, which in the opinion of R.E.M.E., warrants further examination, will be despatched to D.I. Arm. under arrangements to be made by D.D.O.S. Command.

282. Rates of fire - The risk of prematures from all causes will rise when a high rate of fire is maintained for any considerable time. Except for very short bursts of fire, a rate faster than that laid down as "intense" for the equipment concerned should not be ordered.

283. Records of prematures - Many trials have been carried out in order to prove or disprove suggested causes for prematures. Investigations are still continuing and important information on the causes of prematures can be provided if Units render detailed reports regarding any prematures suffered by them.

Full instructions as to the procedure to be adopted on the occurrence of a premature and a specimen of the form on which the relevant facts should be entered are contained in R.A.O.S. Volume III, Pamphlet No. 5, which is issued on the scale of one for each regiment.

#### DEFECTIVE FUZES

284. Defective fuzes (as defined in the gun drills) may cause blinds or prematures, therefore:-

Before medium or heavy shell are fuzed, the fuzes should be inspected as described in the gun drills and any fuze which is defective or which appears to have been damaged in any way will be set aside, reported and not be used for fuzing any shell. With ammunition supplied fuzed, the fuzes should be inspected when preparing the ammunition and any shell with a defective fuze or one which appears to have been damaged must be set aside, reported and not fired.

The fuze covers of combustion time fuzes should be kept on until immediately before use and should not be removed when preparing for ready-use. Any fuzes which are found to be set at anything other than "SAFE" when the cover is removed must be set aside and not fired. It is also important that fuzes should be screwed fully home in the shell and where fuzes such as combustion time fuzes are required to be secured by a fixing screw, that the head of the fixing screw is screwed home below the surface of the shell wall. Similarly, washers if fitted beneath the flange of the fuze must be properly centred as any protrusion will seriously affect ballistics.

#### UNSERVICEABLE FUZES

285. The following ammunition should be treated as unserviceable and on no account should it be fired, or replaced in vehicles:-

- (a) Fuzes Nos. 117, 119 and 213 with damaged or deficient striker covers or discs.
- (b) Shell fuzed with time or time and percussion fuzes which cannot be reset to "SAFE".
- (c) Shell fuzed VT fuzes which cannot be defuzed and plugged.

286. Disposal of defective ammunition - At practice, defective ammunition will be set aside for examination by an I.O.O. (R.A.O.C.).

During operations, defective ammunition will be dumped and clearly marked.

## Chapter 7 Tracers and Tracer - and - Igniters

### Section 1. General

#### INTRODUCTION

287. The policy of providing projectiles with some visible indication of their flight through the air to assist observation by the gunner has developed considerably, and this chapter gives the position to-date. It consists of a device assembled in the base of the projectile to emit light (and usually smoke) to form a trace for a specified time to assist night and day observation.

288. Dark ignition - To obtain a delay in the lighting up of a tracer system so that the path of the "tracer" is not visible until the projectile is some distance from the muzzle, a priming layer of S.F.G.12 powder may be pressed in on top of the ignitory filling (see para.295). This is termed "dark ignition". The object of the "dark ignition" is:-

- (a) to prevent the firer being dazzled by the brilliant flame emitted.
- (b) to reduce the possibility of the position of the gun being pin-pointed by enemy observation from a flank.

Projectiles fitted with "dark ignition" tracers or tracer-igniters are identifiable by special symbols stencilled on the body (see para. 385).

#### CLASSIFICATION

289. Current tracers may be classified under three main heads, viz., :-

- (a) Tracers, shell
- (b) Tracer and igniters, shell
- (c) Integral tracers

290. Tracers, shell are separate components in that they are not integral with the projectile; they are, however, invariably issued assembled with the projectile.

291. Tracer and igniters, shell are also separate components issued assembled with the projectile, but they have the dual function of tracing the trajectory of the projectile and of its destruction at a given time after firing.

292. Integral tracers consist of compositions pressed directly into a cavity (or cavities) formed in the base of the projectile.

## Chapter 7 Tracers and Tracer - and - Igniters

### Section 2. Tracers, Shell

#### DESCRIPTION

293. General assembly - Tracers, shell are normally made of steel or metal rod bored out to take a composite filling of tracing and priming compositions. They may be designed for assembly inside or protrusion outside the base of the projectile and are accordingly known as internal or external tracers. (See Fig.33).

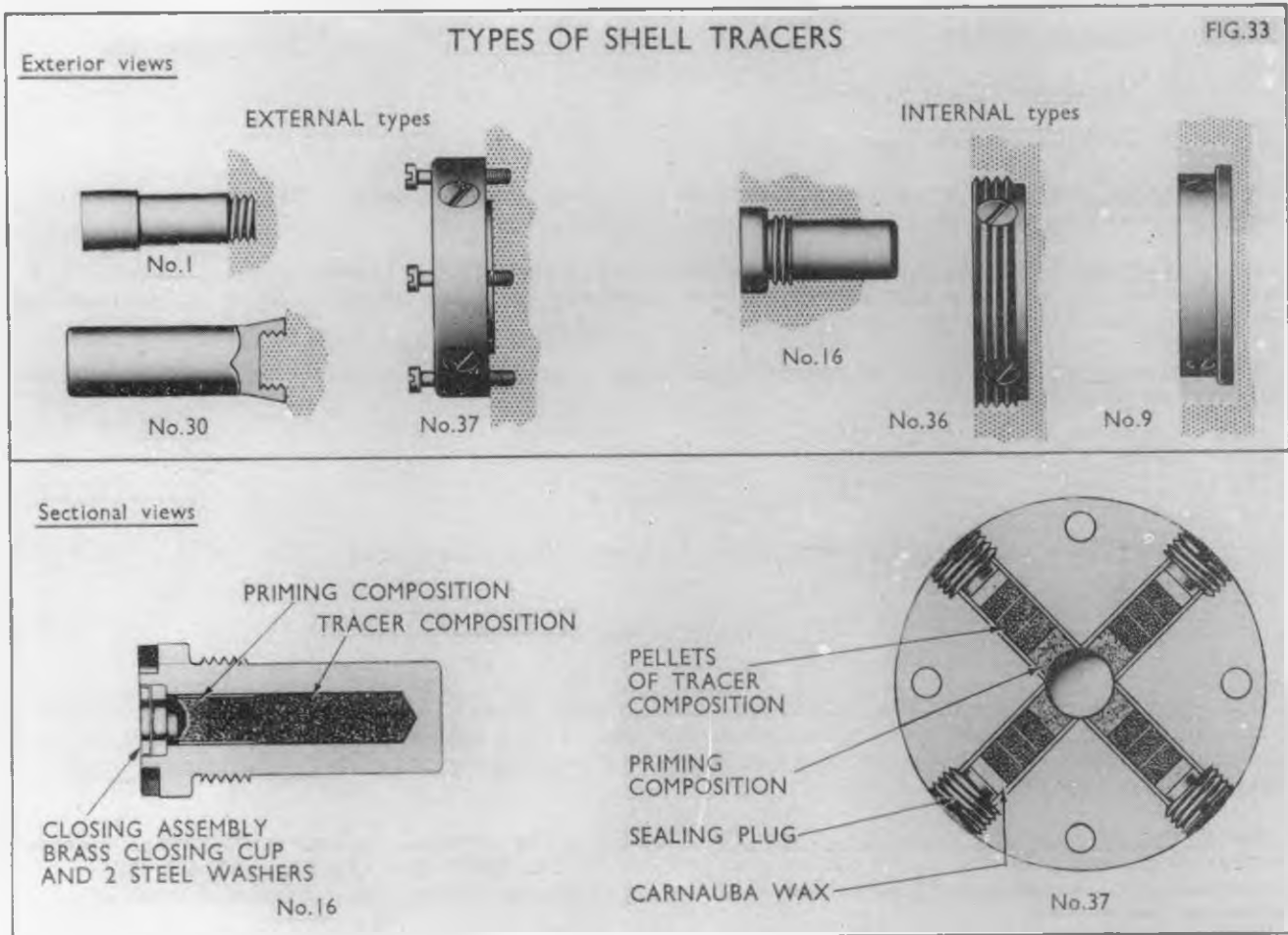
294. Method of securing tracer to projectile (Fig.33) - The external contour of different tracers varies considerably according to the type of projectile for which they are designed and this determines to a great extent the method of securing tracer to projectile. Current methods of securing are:-

- (a) Tracer threaded externally to screw into the base of the projectile. This method of securing is employed in tracer, shell, Nos.1, 16 and 36.

- (b) Tracer threaded internally for attachment to a screw-threaded spigot on the base of the projectile. To prevent independent rotation, the tracer is secured to the spigot by a grub screw. This method of securing is employed in tracer, shell, Nos. 30 and 32.
- (c) Tracer secured by a screwed ring or screws - Tracers secured by means of a screwed ring are designed for use with base fuze shell and normally consist of a disc-shaped steel body in which the tracer channels run at right angles to the axis of the projectile. The tracer and screwed ring are secured after insertion of the base fuze and gascheck plate. This method of securing is employed in tracer, shell, No. 9. Disc type tracers may also be secured by direct screw-threading as in No. 36 or by means of separate screws passing through the tracer body and into the base of the projectile as in No. 37.

295. Priming and tracing compositions - A range of mixtures for tracer filling has been developed, as a result of Service requirements for day and night tracers, giving varied times of burning. Mixtures in general use are priming composition (SR 399) and tracing composition (SR 372 AB) which produce a red trace. Priming compositions are used only to assist ignition of the tracing composition; they give negligible light, whereas tracing compositions give light and luminous smoke for day and night observation. Fillings were formerly pressed in by using a flat serrated punch, but current fillings are pressed with a stepped drift which has proved to give a more satisfactory "take over" from one pressing to the next. The last pressings may be loaded with a hard paper tube impregnated with wax. This is designed to prevent propellant gases from blowing up the side of the filling between its outer surface and the internal wall of the tracer thereby causing short times of burning and, in tracers and igniters, premature detonation of the projectile.

296. Method of sealing tracers - Tracers are sealed by means of brass or celluloid discs or cups, to protect the fillings from moisture and from propellant gases generated during storage. The detailed methods of sealing vary considerably. Because celluloid is liable to soften and become distorted when in contact with nitroglycerine and carbamite, celluloid discs and cups are protected by



bakelised discs when assembled in fixed ammunition rounds. This prevents the celluloid disc or cup from falling into the cartridge case.

ACTION

297. On firing, the tracer sealing arrangements, such as closing cups and discs, are blown in or consumed by the propellant gases and the primary composition ignited. This ignites the tracer composition, the flame from which escapes through the emission hole(s) and enables the trajectory of the projectile to be observed.

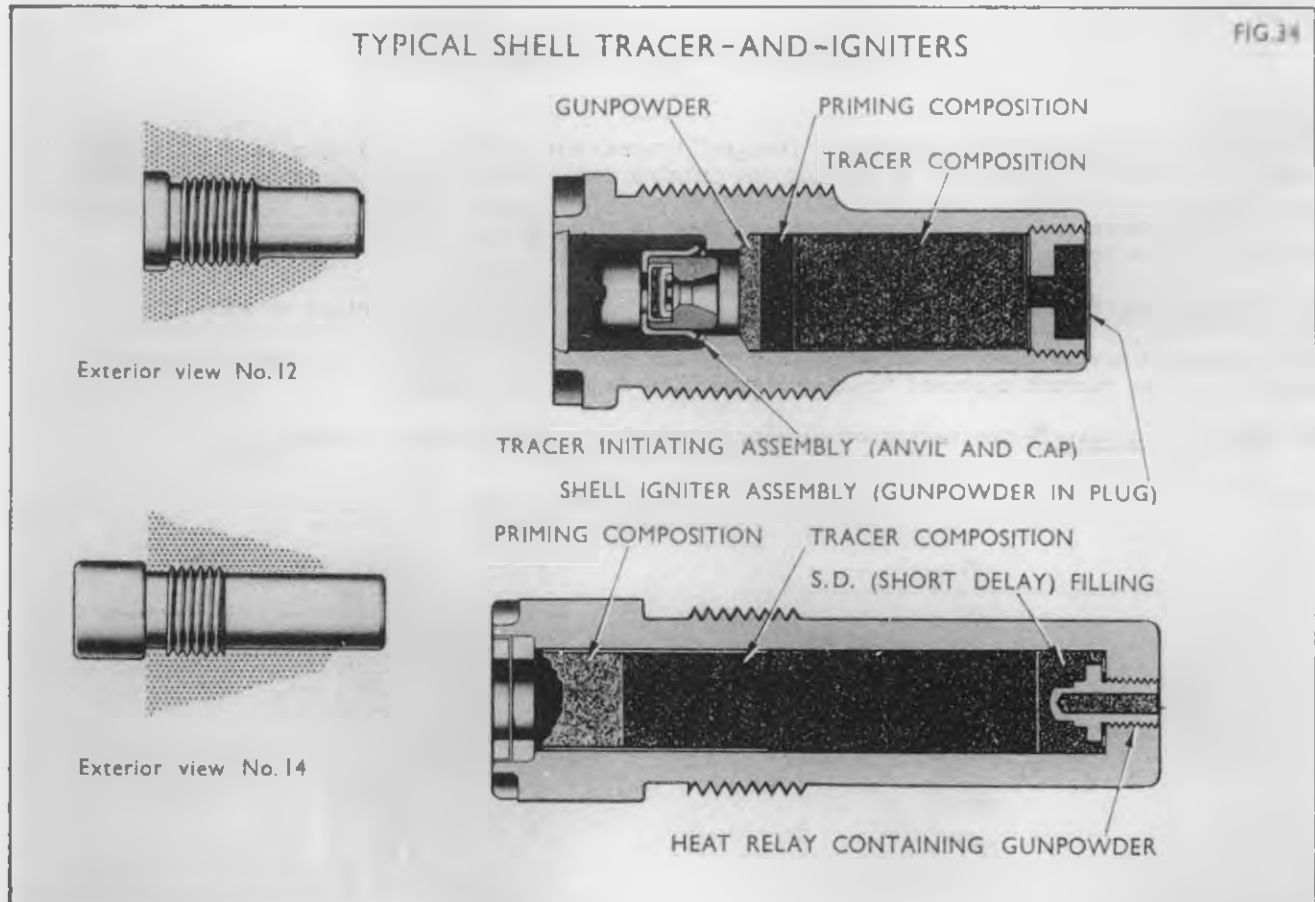
## Chapter 7 Tracers and Tracer - and - Igniters

### Section 3. Tracer-and-Igniters, Shell

DESCRIPTION

298. General assembly - tracers-and-igniters, shell, (Fig. 34) are normally made of steel or brass rod, bored out centrally to take the separate component parts; the initiating and closing arrangements at the rear end, the priming and tracing compositions in the centre and the igniter at the forward end.

299. Initiating and closing arrangements - The initiating and base closing arrangements are similar to those of tracers, shell (see para. 296) except that tracer and igniter, shell Nos. 7 and 12 incorporate a cap and anvil firing mechanism for initiating the priming and tracing compositions. The anvil is a push fit in the rear end of the tracer and igniter and is recessed to take a cap and a cap holder supported by a stirrup spring, the complete mechanism being closed at the base by a lead sealing disc.



300. Priming and tracing compositions - These are the same compositions as used for tracers, shell (see para. 295). In May, 1951, humidity controlled conditions were introduced in tracer filling shops. Existing marks of tracers and igniters filled under the new conditions were allotted "/1" after the mark, e.g:-

Tracer and igniter, No. 11, Mk. 3/1  
Tracer and igniter, No. 14, Mk. 2/1

301. The igniter - The igniter consists of a quantity of gunpowder or S.R. composition lightly pressed into the forward cavity of the body or into a screw-threaded plug (or heat relay). The difference between a plug, as in tracer and igniter, shell, No. 12 and a heat relay, as in tracer and igniter, shell, No. 14 is that the plug filling is ignited by direct contact with the tracing composition, whereas the heat relay filling is ignited by conducted heat.

ACTION

302. The action is similar to that of tracer, shell described in para. 297 except for tracer and igniter, shell, Nos. 7 and 12 in which an anvil and cap mechanism is used. On firing of the latter the inertia of the cap and cap holder overcomes the resistance of the stirrup spring and the cap is fired by the anvil. The flash from the cap ignites the priming composition which in turn ignites the tracing composition. The resultant gases blow out the firing mechanism and sealing disc, thus permitting the flame from the tracing composition to be observed. After a given time of burning the tracing composition ignites the initiating composition in the plug or heat relay to bring about detonation of the projectile.

## Chapter 7 Tracers and Tracer - and - Igniters

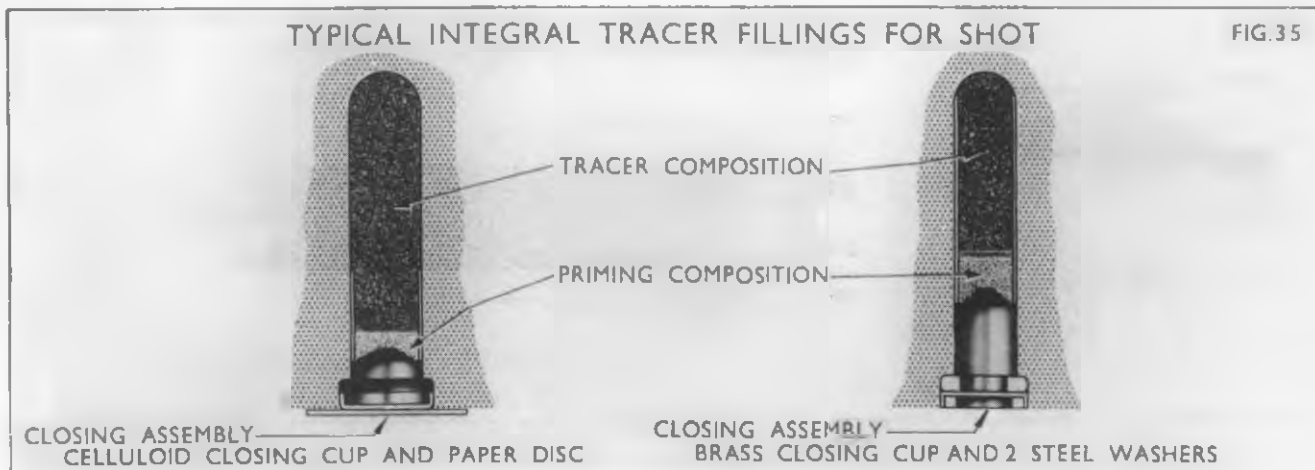
### Section 4. Integral Tracers

DESCRIPTION

303. Method of filling tracer cavities - Integral tracers are normally used only in solid shot and consist of a number of pressings of tracing and priming compositions filled directly into one or more cavities in the base of the projectile. (See Fig. 35). Unlike other types of tracers they are not allotted numbers and marks but may be identified by design, type, model or part number, stencilled on the body of the projectile.

304. Tracing compositions and size of cavity - In February, 1943 it was decided to adopt tracing composition S.R. 372 (red trace) for all armour piercing and practice shot. It was also decided to adopt a standard cavity diameter of 0.435 inch for all shot of 6 pr. to 3.7 inch calibre (both inclusive). The current approved tracing composition is now S.R. 372 AB.

305. Method of closing - The method of closing is similar to that used for tracer, shell.



## Chapter 8 Cartridges, Blank and Paper Shot

### Section 1. Introduction

#### GENERAL

306. Blank ammunition - Blank cartridges consist of a cartridge case and/or a cloth bag containing only a charge, usually of gunpowder although charges of cordite have been approved for some equipments. They must not be fired with any form of projectile, and are provided solely for training, demonstration and saluting purposes.

All Q.F. blank cartridges have a red worsted cloth disc with the word "BLANK" printed thereon fitted in the mouth of the cartridge case. It is shellacked to the outer surface of the retaining cup, if such is positioned in the mouth of the case or, where the cup is positioned well down inside the case, the red disc is affixed to the inside edge of the mouth of the case. The object of this disc is to give a quick visual means of ascertaining that the charge is actually present in the case and that it has not been fired and has not fallen out in handling etc.

307. Paper shot cartridges - Special cartridges may be provided for use with paper shot. Such cartridges must not be fired with any other form of projectile. Paper shot cartridges and paper shot are normally provided for proof of carriages and mountings to simulate firing stresses.

To further assist identification, Q.F. paper shot cartridges will have in addition to the normal markings stencilled on the base and side of the cartridge case, a green paper disc shellacked to the outer surface of the retaining cup positioned in the mouth of the case, or alternatively the outer surface of the retaining cup may be painted light green. The word "PAPER" is also clearly printed on the disc or cup.

## Chapter 8 Cartridges, Blank and Paper Shot

### Section 2. Types authorised for Field Branch Artillery Equipments

#### CARTRIDGE BLANK (Fig. 36)

##### 308. Q.F. 25 pr.

###### Mark 1

This is the normal charge and consists of a mark 2 or 2/1 brass cartridge case fitted with a No.1 percussion primer. The charge consists of 1 lb. of G.12 gunpowder contained in a silk cloth bag. A leatherboard cup is inserted in the mouth of the case, base downwards, and is wedged against the charge and secured with shellac.

###### Mark 2

This is special for Gibraltar for saluting purposes only.

It differs from the mark 1 in that the charge consists of 8 oz. of G.12 gunpowder contained in a worsted cloth bag.

These cartridges must never be used at a rapid rate of fire.

###### Mark 3

This is special for Dover (except with Carriage Q.F. 25 pr. saluting mark 1).

It differs from the marks 1 and 2 in that the charge consists of 2 lb. of G.12 gunpowder contained in a silk cloth bag which is retained in the cartridge case by 3 leatherboard cups.

These cartridges must never be used at a rapid rate of fire.

###### Mark 4

This is the normal equivalent to the mark 1 cartridge.

It differs from the previous marks in having a charge of 1 lb. 4 ozs. of cordite W.M. 017 which is retained in the cartridge case by one leatherboard cup. A No.9 percussion primer is assembled in place of the No. 1 primer.

##### 309. B.L. 5.5 inch, 4.5 inch and 155 mm. gun.

###### Mark 1

This consists of a charge of 3 lb. of G.12 gunpowder enclosed in a silk cloth bag, the mouth of the bag being choked and secured by silk thread.

310. B.L. 7.2 inch

Mark 1

This consists of a charge of 7 lb. of G.12 gunpowder enclosed in a silk cloth bag, the mouth of the bag being choked and secured by silk thread.

PRECAUTIONS TO BE OBSERVED WHEN FIRING BLANK AMMUNITION

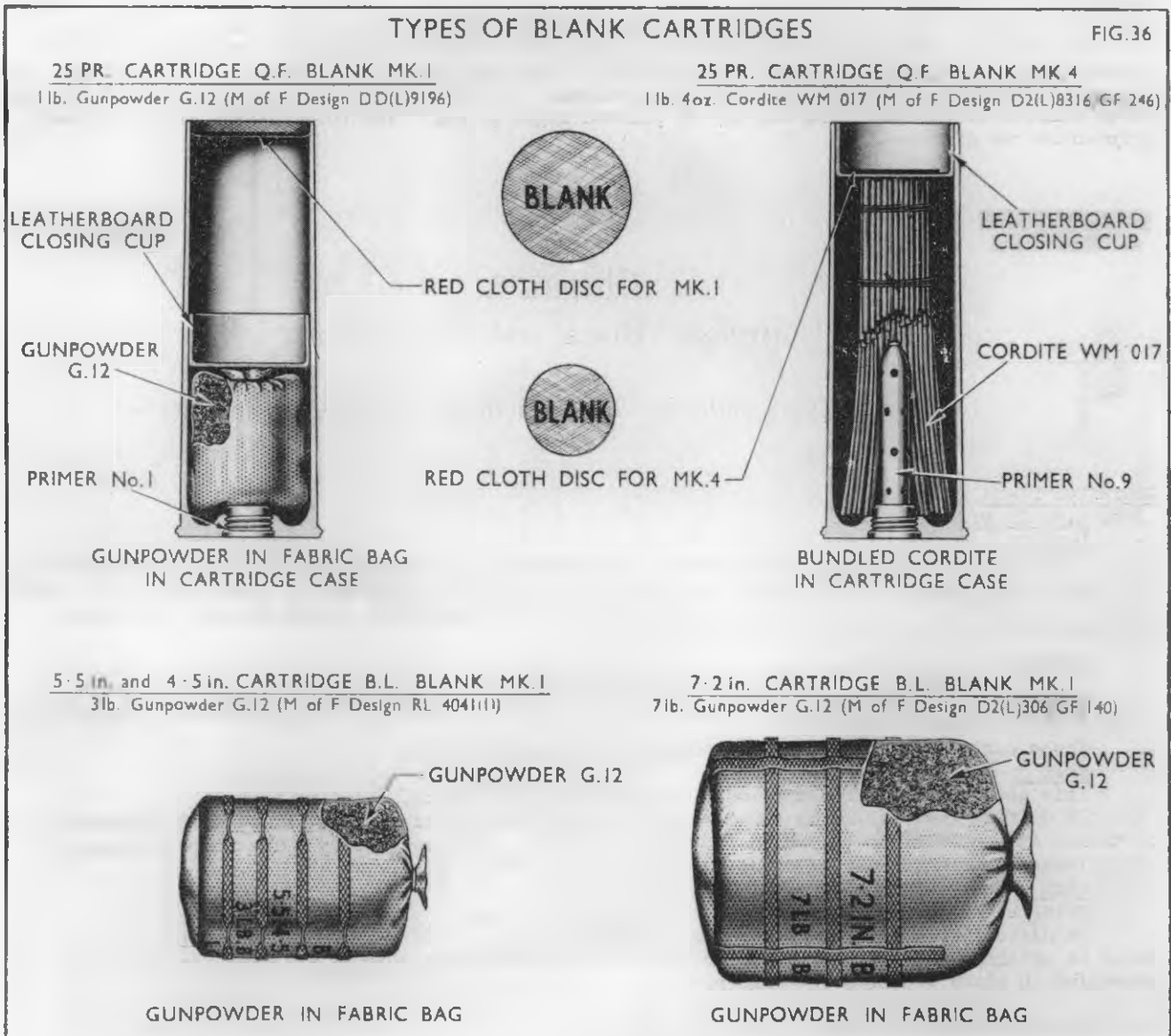
311. When firing B.L. blank cartridges - No gun must be reloaded within 30 seconds after firing. Even after this interval, no gun must be reloaded until the chamber and bore have been sponged out, examined and all debris removed. In the event of a misfire the normal misfire drill must be carried out except that, if the tube has fired, a second tube must not be loaded but the detachment should immediately be ordered to stand clear, care being taken that no one is in the rear of the breech and a pause of not less than 30 minutes be allowed to elapse before the breech is opened.

When firing Q.F. separate loading blank cartridges - In the event of a misfire the breech must not be opened for at least 30 minutes and no one must be in the rear of the breech when it is opened.

CARTRIDGE PAPER SHOT

312. B.L. 5.5 inch Gun

There is only one design i.e., mark 1 consisting of a charge of 9 lb. 4 oz. cordite WM. 109 filled to M. of F. design DD(L)20296. This is in one portion which is fitted with a single 1 oz. "C" gunpowder igniter.





## Chapter 9 Drill Ammunition

### Section 1. Introduction

#### GENERAL

313. Drill stores are provided for practising loading, handling and other drill purposes. They approximate to the shape and weight of the Service store they represent and contain no explosive whatsoever.

Where drill ammunition is made from the material used for the operational store, it is painted black. Exceptions to this rule are:-

- (a) Brass cases used in the assembly of Q.F. drill cartridges - such cases are not painted or otherwise coloured black; instead, they are left in their natural colour but the word DRILL is stamped on the base of the case.
- (b) Drill cartridges or charges made up in the same colour and cloth material as the operational store. These have the word DRILL stencilled in black in a prominent position on each portion.
- (c) Drill stores made from material other than that used for the operational store, e.g., wood, rubber, leather, etc., which are left in their natural state.

Any item of drill ammunition not marked or painted as described in the following paragraphs must be returned to the R.A.O.C. and not used.

Live ammunition, practice as well as operational, must not, in any circumstances, be used for drill purposes.

All preliminary training is carried out with drill ammunition and in peace-time no other nature of ammunition should be on the gun position at the same time. In war, however, although drill ammunition is used for training, operational ammunition may also be on the gun position. This introduces a risk of error and accident which can only be avoided by very careful attention on the part of all concerned. The broad general rule to follow at operational positions or elsewhere when operational ammunition is present is to store the drill ammunition in some central place clear of the guns. It should be brought to the gun position for training only, all live ammunition being segregated and steps taken to ensure that the two types do not get mixed up during drill. On completion of the training period, the drill ammunition should be returned to the central store, all items carefully checked and live ammunition excluded.

## Chapter 9 Drill Ammunition

### Section 2. Components

#### DRILL CARTRIDGES

##### 314. Q.F. 25 pr.

##### Mark 1

This consists of a mark 1 steel drill cartridge case. The charge represents the 1 lb. 11 oz. 4 dr. service charge. Shellacked twine represents the cordite which is enclosed in leather bags coloured red, white and blue and weighing 6 oz. 5 dr., 7 oz. 12 dr. and 13 oz. 3 dr. respectively. The portions are retained in position by a lid, leather, mark 1.

##### Mark 3 (use extended to apparatus, practising, loading)

This differs from the Mark 1 in using a service mark 2 brass cartridge case and in the charge being enclosed in coloured cloth bags in lieu of leather also the rim of the case is milled.

The words 25 pr. Mk. 3 DRILL are stamped on the base.

Mark 3/1 (also for use with apparatus, practising, loading)

This differs from the mark 3 in the use of a mark 5 steel cartridge case, the rim of which is milled.

The words 25 PR. MK.3/1 DRILL are stamped on the base.

315. B.L. 4.5 inch

9 lb. 2 oz. mark 1

9 lb. 2 oz. mark 2

Cloth; third charge; representing a second charge of 6 lb. 7 oz. and additional 2 lb. 11 oz. portion tied together.

2 lb. 15 oz. mark 1

2 lb. 15 oz. mark 2

Cloth; first charge.

These are made up to represent the Service cartridges. Each portion consists of a rolled paper cylinder, closed at each end with a wood plug and contained in a cloth bag provided with four lengths of braid sewn to a cloth strengthening band at the base.

The 6 lb. 7 oz. bag is closed at the mouth with a dummy igniter, the 2 lb. 11 oz. being closed at the mouth by a cloth disc.

The cartridge is brought to weight by being filled with sawdust and lead or iron scrap.

The word DRILL is stencilled on the side of each portion also on the igniter and closing disc. The words "CHARGE THREE" are marked on the side of the assembled cartridge.

The base of the 6 lb. 7 oz. portion bag is also marked "TWO" and that of the 2 lb. 11 oz. portion "NOT TO BE FIRED SEPARATELY".

The 2 lb. 15 oz. cartridge consists of a rolled paper cylinder, closed at each end with a wood plug, surrounded at the igniter end with a short rolled paper cylinder and contained in a cloth bag closed at the mouth by a dummy igniter.

The cartridge is brought to weight by being filled with sawdust and lead or iron scrap.

The word "DRILL" is stencilled on the side of the cartridge head and on the igniter, the words "CHARGE ONE" being marked on the stem.

The mark 2 cartridges differ from the mark 1 in the bags being made of cotton in lieu of silk cloth.

10 lb. 9 oz. mark 1

Cotton cloth; third charge; representing a second charge of 7 lb. 9 oz. and an additional 3 lb. 0 oz. portion tied together.

3 lb. 1 oz. mark 1

Cotton cloth; first charge.

These consist of cotton cloth bags, loaded to weight with rope and lead or iron scrap. The dummy igniters consist of two cotton cloth discs, sewn together and filled with scrap textile material. The ends of the cartridges are stiffened with millboard discs.

The 10 lb. 9 oz. cartridge is in two portions, one 7 lb. 9 oz. and an increment of 3 lb.. The 7 lb. 9 oz. portion has a dummy igniter sewn to each end. The ends of the 3 lb. portion are closed with cotton cloth discs.

The 3 lb. 1 oz. cartridge consists of one bag with a dummy igniter sewn to each end.

The 10 lb. 9 oz. cartridge has the large portion marked "CHARGE" on the side and "TWO" on the end. The small portion has "THREE" on the side and the instruction "NOT TO BE FIRED SEPARATELY" on the end. When the two portions are tied together the ends are hidden and "CHARGE THREE" is shown.

The 3 lb. 1 oz. cartridge is marked "CHARGE ONE".

316. B.L. 5.5 inch

9 lb. 2 oz. mark 1

Cotton cloth; charge four; representing charge three of 6 lb. 10 oz. 8 dr and an increment of 2 lb. 7 oz. 8 dr. tied together.

4 lb. 4 oz. mark 1

Cotton cloth; charge two; representing charge one of 2 lb. 10 oz. 8 dr. and an increment of 1 lb. 9 oz. 8 dr. tied together.

These are made up to represent the Service cartridges. The 9 lb. 2 oz. cartridge consists of two portions. Each portion consists of a rolled paper cylinder, closed at each end with a wood plug and contained in a cotton cloth bag provided with four lengths of webbing sewn to strengthening bands at the base

The 6 lb. 10 oz. 8 dr. bag is closed at the mouth with a dummy igniter and the 2 lb. 7 oz. 8 dr. bag is closed at the mouth by a cotton cloth closing disc.

The portions are brought to weight by being filled completely with sawdust and lead or iron scrap.

The word DRILL is stencilled on the side of each portion, also on the igniter and closing disc. The words "CHARGE FOUR" are marked on the side of the assembled cartridge, the larger portion bearing the word "CHARGE" and the smaller portion the word "FOUR". The base of the larger bag is marked "THREE" and that of the smaller bag "NOT TO BE FIRED SEPARATELY", these base markings are hidden when the two portions are assembled.

The 4 lb. 4 oz. cartridge consists of the two portions. The 2 lb. 10 oz. 8 dr. portion consists of a rolled paper cylinder, closed at each end by a wood plug, surrounded at the igniter end with a short rolled paper cylinder and contained in a cotton cloth bag closed at the mouth by a dummy igniter. It is brought to weight by being filled completely with sawdust and lead or iron scrap.

The 1 lb. 9 oz. 8 dr. increment consists of a bundle of 7 1/4 inch lengths of 1 inch rope weighted with lead sticks and enclosed in a cotton cloth bag closed at the mouth by thread stitching. The increment is secured to the stalk of the large portion by two webbing tapes. The words "CHARGE TWO" are stencilled on the side of the assembled cartridge, the larger portion bearing the word "CHARGE" and the smaller portion the word "T O". The stalk of the larger bag is marked "ONE", this marking being hidden when the portions are assembled.

4 lb. 12 oz. mark 1

Cotton cloth; charge two; representing charge one of 2 lb. 15 oz. and an increment of 1 lb. 13 oz. tied together.

9 lb. 13 oz. mark 1

Cotton cloth; charge four; representing charge three of 7 lb. 3 oz. and an increment of 2 lb. 10 oz. tied together.

12 lb. 9 oz. mark 1

Cotton cloth; full charge; for 80 lb. shell.

These are made up to represent the Service cartridges.

They consist of cotton cloth bags, loaded to weight with rope and lead or iron scrap. The dummy igniters consist of two cotton cloth discs sewn together and filled with scrap textile material. The ends of the cartridges are stiffened with millboard discs.

The 4 lb. 12 oz. cartridge is in two portions, one 2 lb. 15 oz. and an increment of 1 lb. 13 oz. The former has an igniter sewn to each end while the ends of the latter are closed with cotton cloth discs.

The 9 lb. 13 oz. cartridge is also in two portions, one 7 lb. 3 oz. and an increment of 2 lb. 10 oz. The former has an igniter sewn to each end while the ends of the latter are closed with cotton cloth discs.

The 12 lb. 9 oz. cartridge consists of a bag with a dummy igniter sewn to each end.

The 4 lb. 12 oz. cartridge has the large portion marked "CHARGE" on the side and "ONE" on the end. The small portion has "TWO" on the side and the instruction "NOT TO BE FIRED SEPARATELY" on the end. When the two portions are tied together the ends are hidden and "CHARGE TWO" is shown.

When the 9 lb. 13 oz. cartridge, which is similarly marked, is assembled the "THREE" is hidden and "CHARGE FOUR" is shown.

The 12 lb. 9 oz. cartridge is marked with a black band and the words "FOR 80 lb. SHELL ONLY".

317. B.L. 7.2 inch

16 lb. 3 oz. 8 dr. mark 1

Cotton cloth; charge three, core and two sections.

25 lb. mark 1

Cotton cloth; charge four.

These are made up to represent the Service cartridges.

The 16 lb. 2 oz. 8 dr. cartridge consists of a core and three sections of the following weights:- core (section No.1) 6 lb. 11 oz., section No. 2, 2 lb. 3 oz. 8dr. section No. 3, 7 lb. 5 oz.

The core and sections, which are built up of sawdust with lead or iron scrap, are each enclosed in a cotton cloth bag being fitted with a drill igniter consisting of a felt disc and red cotton cloth discs with rows of stitching.

The sections are assembled and tied with their tapes around the stalk of the core, section No.2 at the base end. Tapes from the core are threaded through fairleads on the sections and tied on top of No.3 sections.

The 25 lb. cartridge consists of sawdust brought to weight with lead or iron scrap, contained in a cotton cloth bag choked at the mouth with thread and having a drill igniter incorporated at the opposite end.

7 lb. mark 1

Cotton cloth; charge five increment; for use with charge four in mark 6 howr. only.

13 lb. 11 oz. mark 1

Cotton cloth; charge three; consisting of charge one and two increments tied together.

24 lb. mark 1

Cotton cloth; charge four.

These consist of cotton cloth bags loaded with rope and lead or iron scrap. The dummy igniters consist of two cotton discs sewn together and filled with scrap textile material. The ends of the cartridges are stiffened with millboard discs.

The 7 lb. cartridge consists of a bag with a dummy igniter sewn to each end.

The 13 lb. 11 oz. cartridge consists of charge one of 6 lb. 10 oz. 8 dr. with two increment charges of 2 lb. 2 oz. and 4 lb. 14 oz. 8 dr. tied together with strips of webbing sewn to each charge. The 6 lb. 10 oz. 8 dr. portion has a dummy igniter sewn to the outer end.

The 24 lb. cartridge consists of bag with dummy igniter sewn to each end.

In addition to the usual marking, the word DRILL and charge number is stencilled on each cartridge.

DRILL PROJECTILES

318. Q.F. 25 pr.

Shell mark 1

The shell consists of a hardwood body into which is fitted a mild steel central bolt with lead weight cast on, a brass nose and base and a detachable steel cap.

The nose is screwed on to the top of the central bolt and secured to the body with a steel pin. A steel cap having a knurled band screws on to the head. The base is screwed on to the bottom end of the central bolt and secured by riveting. Weight 21 lb.

The words 25 PR DRILL I are stamped on the side.

Shell mark 2

This differs from the mark 1 in having a rubber body, the rubber being vulcanised on between the brass nose and base, to the core which consists of 12 lead weights held in position at the head by a brass plug and at the base by a hard rubber plug secured by a brass ring.

Weight 16 lb. 10 oz.

The word DRILL is stencilled in white just above the shoulder.

Shell mark 3

For use with apparatus, practising loading.

This consists of a modified steel mark 1 H.E. streamline shell with the driving band turned down and fitted at the nose with a steel or cast iron plug to represent the fuze.

Weight 16 lb. 10 oz.

The words DRILL 25 PR. MK.3 SX1A are stamped on the base. The shell is painted black and 25 PR. MK. 3 DRILL is stencilled above the shoulder.

Shot, mark 1

This is solid, of cast iron, and covered with waterproof canvas except for the nose and base. Weight 15 lb. 7 oz.

The words DRILL 25 PR. I are stamped on the base.

319. B.L. 4.5 inch streamline

Shell mark 1

This consists of a rubber body on which 12 lead weights are fitted, a brass nose, mild steel base and detachable ca.

The rubber body is vulcanised on between the nose and base and the weights held in position at the head by a brass plug and at the base by a hard rubber plug secured by a steel ring.

Weight 43.3/4 lb.

The word DRILL is stamped on the base and also stencilled on the body just above the shoulder.

Shell mark 2

The shell consists of a hardwood body, centrally bored and recessed to accommodate a lead weight cast on a central steel tube which is screw-threaded externally at each end for fixing the nose and base. A steel plug fitted with a detachable cap is screwed into the nose. A brass collar is secured round the body by six screws.

The words DRILL is stamped on the base and also stencilled in white above the brass collar.

320. B.L. 5.5 inch streamline

Shell mark 1

This consists of a rubber body, lead weights, a base and head of mild steel, and a brass nose fitted with a screwed detachable cap of steel.

The body is vulcanised on to the head and base pieces and 11 lead weights are inserted into the bore of the shell. The weights are situated between the brass nose, which screws into the head, and a steel disc with a hard rubber plug fitted into the base. The brass nose is secured by a fixing screw and the disc and plug by a steel ring. Steel discs may be inserted at one end of the bore to prevent movement of the weights. Weight (without steel cap) 68.3/4 lb.

The words DRILL 5.5 I are stamped on the base.

Shell mark 2

This represents the 80 lb. and 100 lb. shell.

It consists of a hardwood body, centrally bored and recessed to accommodate a lead weight cast on a central steel tube which is screw-threaded externally at each end for fixing the nose and base. A steel plug fitted with a detachable cap is screwed into the nose. A brass collar is secured round the body by six screws.

The word DRILL is stamped on the base and also stencilled in white above the brass collar.

Shell, L4, mark 1

For apparatus, practising loading, B.L. 5.5 inch guns, mark 1.

It comprises a body and a nose plug. The body is that of the mark 3 streamline H.E. shell modified by levelling the driving band to the diameter of the shell and cutting a square shoulder 22.15 inches from the nose end to a diameter of 5 inches.

The shell is painted black all over and marked 5.5 G MK. I DRILL L4. Mk. I on the base and side.

321. B.L. 7.2 inch streamline

Shell mark 1

The shell consists of a hardwood body, nose plug and four segments. The segments are screwed to the body and plug and a steel plate is screwed to the base. The whole is covered by rawhide stretched on to the shell and laced. Copper tacks further secure the rawhide near the top and base.

The mark and words 7.2 IN. DRILL are stamped on the side.

DRILL FUZES

322. Identification - These may be of new manufacture or adapted from Service fuzes by emptying or burning out the explosive elements.

All drill fuzes are coloured black with the exception of the graduated portion and setting index of time fuzes.

Percussion fuzes, where practicable, are bored right through from nose to base and horizontally through the body.

Time and percussion fuzes, where practicable, are bored horizontally through the cap and vertically from the base to the horizontal boring.

(a) Stampings - Fuze number and mark

The word DRILL is normally stamped on the fuze body in large type.

The fuze number, mark and the word DRILL are filled in with white paint.

(b) Stencilling

This is in white where used in lieu of stamping.

DRILL PRIMERS

323. Identification - These may be of new manufacture or made from converted fired primers. A hard rubber plug is inserted in the percussion cap recess in the base. The body of the primer is blackened all over.

Stampings

The word DRILL in large type

Number and mark

Manufacturers initials or trade mark

} are stamped on the base

DRILL TUBES, S.A. PERCUSSION

324. Identification - Three elongated indents equally spaced are formed around the case and filled in with red paint, the remainder of the case being blackened all over.

The anvil is also removed from the cap chamber.

Stampings

Manufacturers initials or trade mark }  
Mark of tube } are stamped on the base.

## Chapter 10 4.2 inch Mortar Ammunition

### Section I. Introduction

#### EQUIPMENT

325. Mortars are designed to throw bombs at comparatively short ranges and at steep angles of descent. Design is governed by similar considerations, as regards set-back, as are applicable to guns, but the chamber pressure and muzzle velocity are far smaller. Most modern mortars are smooth bore and are loaded from the muzzle end. They are never fired at low angles of elevation, as an almost vertical angle of descent is required.

The ordnance M.L. 4.2 inch mortar is equipment of Field Branch Artillery units and is used mainly in counter mortar bombardment role.

#### AMMUNITION

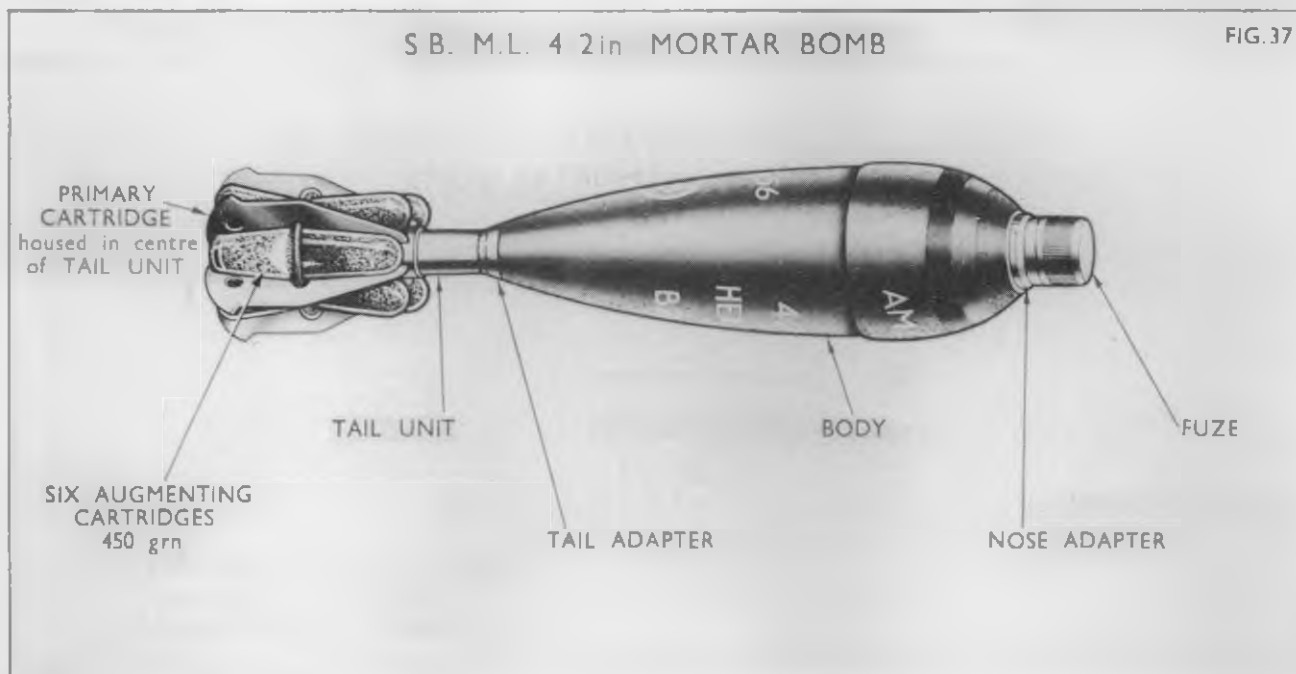
326. Modern mortar bombs are made of cast iron, forged or cast steel and are streamlined in shape and fitted with vanes on the base end, or on a rearwardly projecting tail. The air pressure on the vanes during flight prevents the bomb "toppling" and ensures a reasonably stable head-on flight.

S.B., M.L. 4.2 inch mortar ammunition (Fig. 37) is normally issued as assembled rounds complete with fuze, tail unit, primary and augmenting (or secondary) cartridges. The primary cartridge is assembled in the central tube formed in the tail unit while the augmenting cartridges are placed between the vanes of the tail unit and retained in position by a spiral spring threaded through holes formed in the vanes. The tail unit, with the primary and augmenting cartridges assembled, is protected in transit and storage by a waterproof cover secured by tapes. Each round is normally packed (complete with cartridges and fuze assembled) in a metal container. These are packed in single or two round carriers, two carriers being packed in a box. For overseas issue bombs may be issued plugged, with fuzes, primary and augmenting cartridges each packed separately.

The ammunition is classified under the following nomenclatures:-

Bomb, S.B., M.L., H.E. streamline  
" " " " drill, streamline

327. Cartridges- All bombs are fitted with primary cartridges complete with striker clips, and six 450 gr. augmenting cartridges (see Fig. 38).



WATERPROOFING AND RUSTPROOFING

328. Bomb bodies - (except the screw threads) and guide-bands were formerly coated internally and externally with lead-free copal varnish and then stoved. The practice was current for all bomb bodies, including those filled with white phosphorus, until 1952. Bomb bodies off production from that date are phosphated on the exterior surface including the guide-bands. They are then coated externally, with the exception of the guide-bands and front and rear annular surfaces of the body, and internally, with the exception of the screw-threads, with one coat of lead-free copal varnish. They are then stoved. The screw-threads and guide-bands are coated with lanoline solution.

329. Containers, nose, adapters nose, and adapters tail - All nose containers and adapters were coated with lead-free copal varnish and stoved until 1952, when rustproofing by an approved phosphating process was introduced as a pre-requisite of varnishing.

330. Tail units - Current production of tail units are rustproofed internally and externally by an approved phosphating process. They are then coated with lead-free copal varnish and stoved. The screw-threads are coated with lanoline solution.

CLIP, SAFETY PIN, SPECIAL (Fig. 38)

331. In shape this is similar to a commercial type safety pin. It is inserted through holes in the cartridge container of H.E. streamline bombs and prevents the primary cartridge falling out in transit and handling or when being loaded into the mortar.

COVER, TAIL, M.L. 4.2 INCH MORTAR

332. The propellant charges are protected from wet, moisture and damage during storage and transit by a waterproof cover which is placed over the tail unit and is retained in position by securing tapes.

While the mark 5, which has a hard base and a thick millboard disc to protect the primary cartridge from premature ignition, is the latest pattern, the mark 3 which is of cotton fabric proofed with nitrocellulose was also used extensively when reconditioning stocks of bombs.

SPRING, RETAINING, CARTRIDGES, AUGMENTING

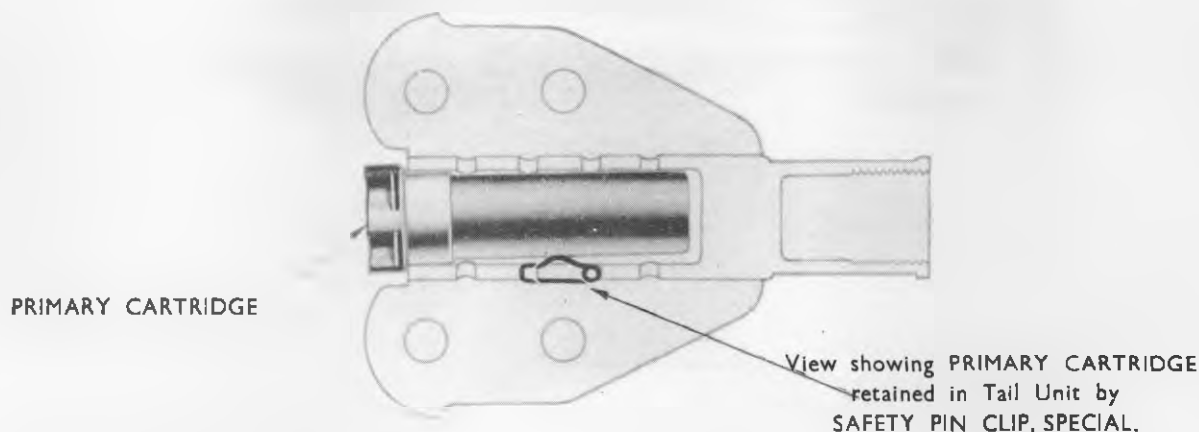
333. This is made of No. 26 s.w.g. (0.018 inch) spring steel wire, spirally wound with hooks formed at each end. It is 5.25 inches in length and 0.187 inch in diameter. It is inserted through holes formed in the vanes of the tail unit and is used to secure the augmenting cartridges in their correct position, at the same time permitting the quick and easy withdrawal of cartridges which may be necessary to effect alterations in charge.

MEANS OF IGNITION

334. The bomb, with tail cover removed, is loaded tail unit first into the muzzle end of the mortar. The weight of the bomb causes it to slide quickly down the barrel until the clip on the base of the primary cartridge hits the striker stud positioned centrally in the breech piece of the mortar. The force of impact causes the striker point formed on the inner side of the clip to be driven on to the cap in the base of the primary cartridge which fires and ignites the charge in the cartridge case.

METHOD OF RETAINING PRIMARY CARTRIDGE IN  
S.B. M.L. 4.2in. MORTAR BOMB

FIG. 38





The resultant explosion bursts through the sides of the paper case, through the holes formed in the cartridge container, and ignites the augmenting cartridges positioned between the vanes of the bomb tail unit. The gases generated quickly build up pressure causing the bomb to be propelled up the muzzle at a comparatively high speed.

## Chapter 10

### 4.2 inch Mortar Ammunition

#### Section 2. Bombs

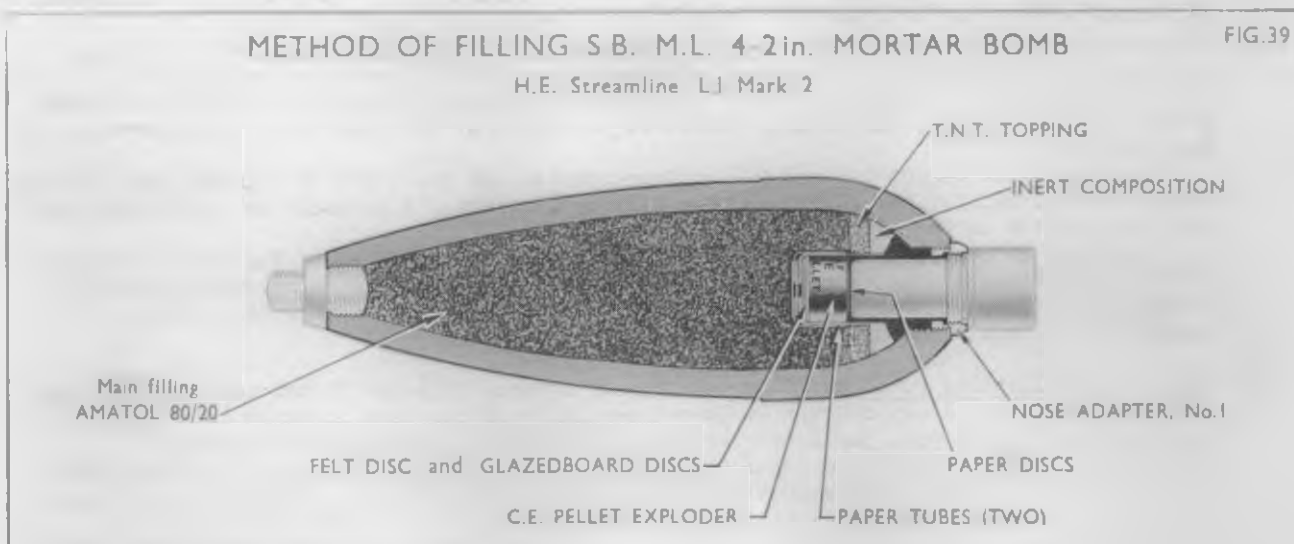
**BOMBS, S.B., M.L., H.E. STREAMLINE (Fig. 39)**

335. Empty designs - There are several marks of streamline bombs in the Service, the body of which tapers towards the head and base, a tail unit being secured to the base adapter which comprises a cartridge container having a number of gas escape holes formed therein and which is fitted with six vanes. The main difference in the marks, all of which are threaded internally at the head to the 1.375 inch fuze-hole gauge, is in the material used for the body and in the combination of adapters and tail units which are as follows:-

<u>Mark</u>	<u>Material of body</u>	<u>Nose adapter</u>	<u>Tail adapter</u>	<u>Tail unit</u>
1	Cast iron	No. 1	No. 1, Mk. 2	No. 2, 3 or 9
1/1	" "	"	No. 3, Mk. 1	No. 4
1/2	" "	"	No. 4, Mk. 1	No. 7 or 9 or TV 9 SA
2	Steel	"	No. 1, Mk. 2	No. 2 or 3
2/1	"	"	No. 3, Mk. 1	No. 4
2/2	"	"	No. 4, Mk. 1	No. 7 or 9 or TV 9 SA
3	Cast iron	No. 1 Mk. 1 or 1/1	No. 4, Mk. 1	TV 10 SA

Part No. TV 8 GE Cast iron No. 1 Mk. 1 or 1/1 TV 90 TV 9 SA  
 (When filled this bomb is designated "Bomb, S.B., M.L., H.E. streamline, 4.2 inch mortar, L1 mark 1")

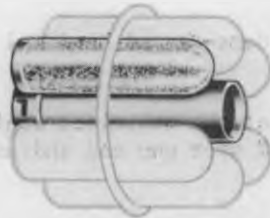
Part No. TV 10 GE Cast iron No. 1 Mk. 1 or 1/1 TV 100 TV 10 SA  
 (When filled this bomb is designated "Bomb, S.B., M.L., H.E. streamline, 4.2 inch mortar, L1 mark 2")





# PRIMARY CARTRIDGE AND AUGMENTING CARTRIDGE for S.B. M.L. 4.2in. MORTAR BOMB

FIG. 40



Composite view of  
PRIMARY CARTRIDGE  
with cluster of SIX  
AUGMENTING CARTRIDGES

Note. The Primary cartridge is inserted inside the central tube of the Tail Unit and the Augmenting Cartridges are assembled outside, between the vanes of the Tail Unit.

## PRIMARY CARTRIDGE

CLIPPED TYPE CARTRIDGE showing Initiating assembly of STRIKER with STRIKER CLIP PERCUSSION CAP and ANVIL.



COMPRESSED PAPER WAD

GUNPOWDER PRIMING

CELLULOID CUP

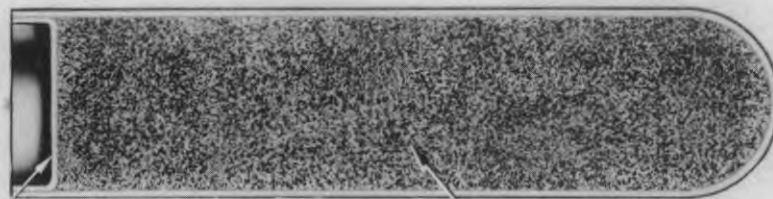
PROPELLANT, BALLISTITE B.16 (140 grn)

CARDBOARD DISC

FELT WAD

CARDBOARD DISC

## 450 grn. AUGMENTING CARTRIDGE



CELLULOID CLOSING CUP

PROPELLANT NRN9 (NEONITE No. 9)

CELLULOID CASE

AUGMENTING CARTRIDGE (Fig. 40)

339. This consists of two marks as follows:-

Cartridge, S.B. M.L., 4.2 inch mortar, streamline, augmenting  
450 grains N.R.N. No. 9

Mk. 1 (obsolescent)  
Mk. 2

The mark 2 cartridge is a moulded celluloid container with a dome-shaped head and is closed at the open end by an inverted cup.

The mark 1 cartridge is similar in shape differing only in that the celluloid container is not moulded. It is in the form of a cylindrical tube with a cap affixed over one end and an inverted cup affixed in the other end.

DRILL CARTRIDGES (PRIMARY AND AUGMENTING)

340. These are similar to the Service equivalent except that they are filled with sawdust or sand. They have the word DRILL prominently marked on the body.

## Chapter 11 Records

### Section 1. Purpose and Application of the Lotting System

#### INTRODUCTION

341. With minor exceptions, empty ammunition components are produced in what are known as "lots", each lot being as homogeneous as possible. Bulk H.E. and propellants are also produced in lots, each lot normally being the produce of one run of production of a particular mix or blend. Lots of empty components which are to be filled are normally "married" to particular lots of H.E. or propellant, components so filled being given a filled lot number. This system of lotting is designed to ensure that specific quantities or lots of components are as homogeneous as possible both in non-explosive and explosive material and, under similar conditions, may be expected to give uniform performance in the Service.

The numbers of units forming a lot varies, and may range from 1,000 for primers, or 2,000 for mechanical time fuzes to 20,000 or more for small-calibre propellant charges.

A lot number is allocated to each lot and wherever possible each item is marked with the lot number to facilitate identification.

The Inspectorate of Armaments maintains extensive technical records of all lots, also of the complete rounds, and is in a position to investigate any defect arising later, and in most cases, trace its cause.

#### PROPELLANTS

342. Propellant charges deteriorate in store and the rate of deterioration depends mainly on the storage temperature. Efforts are made to store all cartridges of the same propellant lot number under similar conditions and careful records of the storage temperature are kept in peace and reported to the Inspectorate of Armaments. From these sources, and from the records of periodical technical tests, the remaining "life" of the lot is determined. In war, periodic chemical tests are impracticable, while in mobile units the recording of storage temperatures cannot be done satisfactorily, so both requirements are suspended. This can be permitted with reasonable safety as most cartridges are made up with modern propellants which should not cause any anxiety as to stability for at least five years.

## Chapter 11 Records

### Section 2. Purpose and Application of the Batching System

#### INTRODUCTION

343. Rounds of fixed ammunition consist of four main components, viz., fuze, projectile, propellant and primer and are normally assembled by selected lots of such components. This system is designed to ensure that specific groups of complete rounds are as homogeneous as possible and may be expected to give a uniform performance when fired from the same weapon. Rounds so assembled form what is known as a "batch".

#### PURPOSE OF BATCHING

344. The objects of the batching system are:-

- (a) To ensure consistent performance on firing, with minimum round-to-round variation.
- (b) To simplify identification of rounds when an unsatisfactory report is made on a particular lot of components.

- (c) To simplify the tracing and withdrawal of life-expired components or those which have been superseded by later marks and types.
- (d) To identify a definite quantity in which the results of inspection, proof and test can be representative.
- (e) To facilitate the maintenance of simple records.
- (f) To reduce the amount of stencilling on ammunition packages.

THE BATCHING SYSTEM

345. Although the ideal batch is one in which each component is of one filled lot, this is seldom attainable in practice since different components are manufactured and filled in varying quantities. Propellants, for example, are blended and manufactured in lots of anything up to 100,000 lb., fuzes and primers are normally filled in lots of 2,000, whilst projectiles are produced in varying quantities depending on the availability of materials and machining capacity. Assuming that 100,000 lb. of propellant is sufficient to fill 10,000 charges, 5 lots of fuzes and primers, and possibly several lots of projectiles would be needed for the assembly of 10,000 complete rounds. In such a case the only constant is the propellant and even though the lot to lot variation of other components is limited by careful acceptance tests and inspection, complete homogeneity of the 10,000 rounds is lost.

To offset this disadvantage, a system of batching and sub-batching by component lots has been devised. Regularity in the ballistic performance of most natures of ammunition is dependent upon one major component, the others being of secondary or minor importance. Thus, fixed Q.F. ammunition is invariably batched on the major or primary component (usually known as the governing component), and is divided into smaller groups or sub-batches on the next most important component (usually known as the secondary component), other components being of relatively lesser importance. Referring to the example given in para.351 and taking the propellant and fuze as the governing and secondary components respectively, the batch would contain 10,000 rounds of one propellant lot, divided into 5 sub-batches each containing one fuze lot.

It follows that a batch of ammunition should contain one lot only of the governing component, sub-batches being formed when more than one lot of the secondary components is required to complete the assembly of a batch.

Other component lots are kept as uniform as possible during the assembly of the complete rounds, but for all practical purposes variation in lot numbers is disregarded.

APPLICATION OF THE BATCHING SYSTEM

346. The types of ammunition assembled under the batching system are:-

Qtges. Q.F. fixed; M.L. mortars and rockets 3.5 inch.

Within these types the governing and secondary components vary considerably and are detailed below:-  
The batching and sub-batching components are:-

Batching component - propellant  
Sub-batching component - fuze

347. Cartridges Q.F. fixed - plugged - Rounds assembled with one propellant lot are given the same batch number. If fuzeing is subsequently undertaken by RAOC, sub-batching will be carried out in accordance with instructions issued by H.Q. Ammunition Organization, RAOC.

348. Cartridges Q.F. fixed in which fuzes and plugs are not used - Batching is governed by the propellant lot and batches may be divided into sub-batches, each containing one lot only of the next most important component. Components used as the basis of sub-batching are detailed below:-

<u>Component</u>	<u>Type of Ammunition</u>
Filled shot	Shot with integral tracer
Tracer	Shot with external tracer
Shot	Shot without tracer (e.g. break-up shot)
Filled projectile	Filled projectile without fuze (e.g. smoke emission)

349. Fuzed M.L. mortar bombs - are batched by filled fuze lots (not by the propellant lot) and sub-batched, where necessary, by the primary cartridge lots.

IDENTIFICATION OF BATCHES AND SUB-BATCHES

350. Batch numbers and prefix letters - Every batch is allotted a batch number by the Inspectorate of Armaments at the time of assembly. Such numbers normally run consecutively for any given nature.

Each batch has a prefix letter which indicates the nature of projectile and charge. Prefix letters in current use are:-

OPERATIONAL AMMUNITION	
Full Charge	Reduced Charge
B - H.E.	M - H.E.
C - Smoke (screening)	
D - Smoke (coloured)	
E - Piercing shot	
F - Break-up shot	
G - Inert projectile	
K - Projectile, flare, coloured	
L - Projectile illuminating	
N - Canister	
W - Shell radar echo	
PRACTICE AMMUNITION	
Full Charge	Reduced Charge
S - Practice projectile (filled)	U - Practice projectile (filled)
T - Practice projectile (weighted)	X - Shot flat-headed and shot practice pointed

The letters I, O, P and V are not used as batch prefix letters

351. Batch suffix letters - The parent batch number is allotted a suffix letter for each sub-batch. Thus, if batch B34 were divided into three sub-batches, they would be numbered as follows:-

B34A, B34B and B34C

B is the batch prefix letter indicating a full charge with H.E. shell. 34 is the batch number, i.e., the 34th batch of B type rounds produced for the equipment. A, B and C are the sub-batch letters indicating 1st, 2nd and 3rd lots of fuzes (or other sub-batch components) respectively.

All other components, e.g., tracers, primers, cartridge cases etc. in the sub-batch are restricted as far as possible to one lot of each component, but do not affect the batch number.

I and O are not used as batch suffix letters so that the number of sub-batches of a parent batch cannot exceed 24. In some natures of Q.F. fixed ammunition, e.g., 2 pr., the number of cartridges which can be filled from one propellant lot (say 100,000 lb.) exceeds the number which can be included in 24 sub-batches, since the secondary component (normally the fuze) is in lots of 2,000. In such cases, further batch numbers are allotted, as necessary for the same propellant lot, and sub-batching is continued as before.

Similarly, a propellant lot may be exhausted while a sub-batch is being assembled. Under these circumstances, the balance of the secondary component lot is used in the assembly of the first sub-batch of the next batch.

As there are more propellant charges in a lot than there are combustion time fuzes in a lot, it follows that the majority of cartridges batched on the fuze will not require to be sub-batched and therefore the absence of any sub-batch letter need cause no comment.

The batching system and marking is designed to help the gunner, the store-holder and the central records. The main features to note are:-

All propellant charges in a batch are ballistically equal.

Cartridges should be stored according to batches where these exist, and all ready-use rounds at a gun should be from the same batch or sub-batch.

352. Allocation of new batch numbers and sub-batch letters - When, for any reason, original components are replaced in the service by components of another lot, new batch numbers and letters will normally be allotted by H.Q. Ammunition Organization RAOC, as follows:-

Primary component - new batch number  
Secondary component - new batch letter

NOTE When 24 sub-batches already exist, a new secondary component may entail the allocation of a new batch number.

The exchange of other components with new lots does not affect the batch number or sub-batch letter, though it is indicated by stencilling the letter 'X' (in red) after the batch number or sub-batch letter on packages and inner containers.

#### AMMUNITION AND PACKAGE MARKINGS

353. A batch label inside the package gives details of the batch and its components.

The batch letter, number and sub-batch letter (where applicable) is stencilled, in silver nitrate, on the side of the cartridge case in Q.F. fixed ammunition, and in white lettering on the body of mortar bombs. The batch letter, number and sub-batch letter (where applicable) is stencilled on the side and ends of all packages. When batched ammunition is packed in closed inner containers or carriers which can be removed from the outer package, the inner container or carrier will normally be stencilled with the batch number. In the case of tinned plate containers, printing may be used in lieu of stencilling.

354. Packing serial number - Every package containing British ammunition is also given a packing serial number which is stencilled on the ends of the package.

Whenever a fresh batch or sub-batch is commenced, a new series is taken up, numbering from one, consecutively. That is to say, each batch is contained in packages numbering from one to whatever number is allocated to the last package completing the batch.

A detailed record is kept of all sub-components forming the cartridges in the package, consequently if the cartridge type letter, batch number, sub-batch letter and packing serial number is quoted, the Inspectorate of Armaments can produce complete details of the contents of the package.



## Chapter 12

### Identification Colours and Markings

#### Section 1. Introduction

##### GENERAL

355. A system of distinctive basic body colours, markings and symbols, which are standardized to the largest possible extent, is applied to ammunition and packages for the following reasons:-

- (a) to facilitate the issue and use of the correct nature and type and to enable the store to be easily and clearly identified in the field.
- (b) to facilitate handling, transport, sorting and storage according to the nature of the explosive risk under which classified.
- (c) to enable details of the nature and method of filling design, the filler and date of filling, the specific "lot" and other manufacturing details to be readily ascertained with the view of facilitating investigations into the causes of prematures, blinds or other failures or defects.
- (d) to denote special instructions, precautions or limitations in the handling, segregation, storage and use.
- (e) to provide protection against damage, rust, corrosion, etc.

##### FORMS AND APPLICATION

356. These identification particulars may be applied as follows:-

- (a) Stamping, embossing, engraving, etc - These normally relate to empty components and the manufacture of the unfilled store, but in the case of fuzes, tracers, tubes, etc., they also include the filled details.
- (b) Distinctive overall or basic body colours - Besides providing a protective coating, are also adopted to indicate the type of projectile, such as, high explosive, smoke, chemical, shot, etc.
- (c) Stencilling - The details stencilled on ammunition and packages relate to the type, the nature of the filling, the particular method of filling design, the filled series "lot" or "batch", the filler and date of filling, etc.
- (d) Symbols - These are employed for special identification purposes. They are usually of special shapes and applied in contrasting colours to the remaining details stencilled on the store.

Markings are important in that they provide a complete history and means of identification. In handling and transportation care must be taken to avoid damaging or obliterating the markings.

The following sections show details of the colours and stencilling particulars and symbols to be found on current ammunition and packages, together with their significance.

## Chapter 12 Identification Colours and Markings

### Section 2. Cartridges

#### METHODS OF COLOUR IDENTIFICATION AND MARKINGS

357. Cartridges will normally be identified by one or more of the following means:-

- Colour markings.
- Coloured or dyed fabrics.
- Stencilling.
- Stamping.
- Labels.

358. Colour markings - Basic body colours involving the use of paint are not used for identification, as paint on cartridge bag fabrics or on cartridge cases might introduce undesirable effects. An exception of this rule, however, may occur in certain identification markings on the base of cartridge cases for new equipments which relate to matching projectiles.

In Land Service, the following identification colour markings are used:-

#### Charges B.L. 5.5 inch gun

A black band, 1 inch wide and 7 inches from one end of a B.L. 5.5 inch gun cartridge denotes a super charge for use with 80 lb. shell only.

#### Charges Q.F. 25 pr.

The normal charge consists of three portions, each contained in a coloured cambric bag:-

1st portion (red bag )	- 1st charge )	2nd charge )	3rd charge
2nd portion (white bag )			
3rd portion (blue bag )			

The intermediate charge increment (for use with charge 1 and 2 only) is contained in a white cylindrical cambric bag, and is identified by being marked axially with red stripes 5/8 inch wide at 5/8 inch intervals.

359. Drill cartridges - Where drill ammunition is made from the material used for the operational version, it is painted or otherwise coloured black all over. Exceptions to this rule are:-

Brass cases are not painted or otherwise coloured black; instead, the word DRILL is stamped on the base of the case.

Drill cartridges made up in the same colour and cloth material as the equivalent Service store, have the words DRILL stencilled in black in a prominent position.

When made from material other than that used for the equivalent operational store, e.g., wood, rubber, aluminium, etc., it is left in its natural state, the word DRILL being stamped or engraved on the base.

360. Dummy cartridges - These have no identification basic colour markings and are left in the natural colour of the material from which they are made. The word DUMMY is stamped or engraved on the base.

361. Coloured or dyed fabrics - Dyed fabrics are used for making up igniter bags and in the case of Land Service they aid identification of the charges for certain Q.F. separate loading cartridges.

362. Stencilling - Stencilling is the only method of indicating particulars relating to the filling on assembled cartridges. Particulars relating to the filling are stencilled in silver nitrate. In exceptional circumstances, where delay entailed by the use of silver nitrate cannot be accepted, special paint may be used. The use of such paint for marking is restricted to the minimum.

IDENTIFICATION MARKINGS FOR 25 PR CARTRIDGES

FIG.41

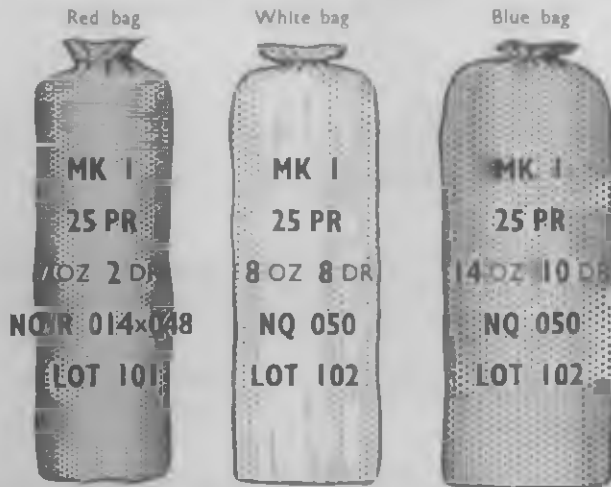
MARKINGS ON CARTRIDGE CASES



**KEY TO STENCILLED MARKINGS**  
 NQ R 014x048 } Propellant Identification letters,  
 NQ 050 } Shape letters and Size figures  
 LOT 101 } Propellant Lot Numbers  
 LOT 102 }  
 MK I ——— Mark of Filled cartridge (on side and base)  
 CY..... Recognized Mark (or initials) of Filler  
 6/47..... Date of Assembly (month and year)

MARKINGS ON

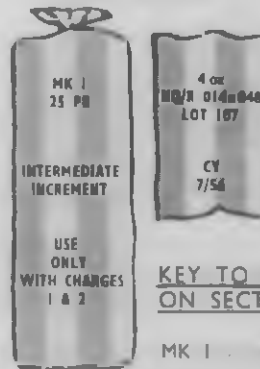
SECTIONED CHARGES FOR COMPOSITE CARTRIDGES



ON REVERSE SIDE OF EACH BAG  
 Recognized Mark (or initials) of Filler  
 Date of Filling (month and year)

NQ R 014x048 } Propellant Identification  
 NQ 050 } letters Shape letters  
 WM 061 } and Size figures

INTERMEDIATE CHARGE INCREMENT



SUPER CHARGE INCREMENT

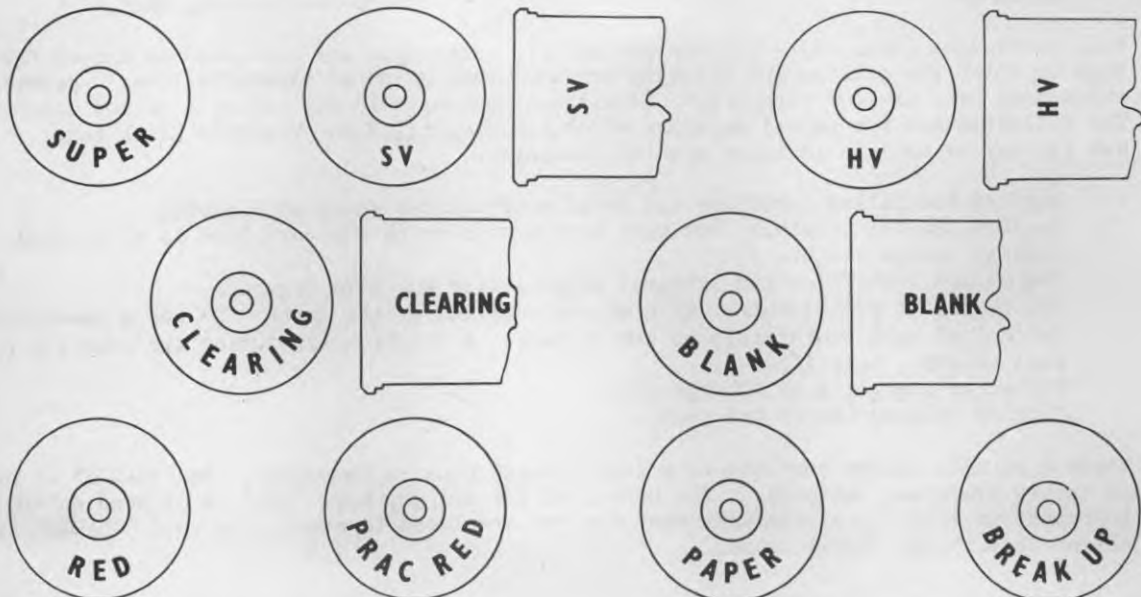


**KEY TO STENCILLED MARKINGS ON SECTIONED OR INCREMENTAL CHARGES**

MK I ..... Mark of Filled cartridge  
 25 PR..... Calibre  
 4oz or 4 1/2oz }  
 7oz 2DR } Nominal Weight of charge  
 8oz 8DR }  
 14oz 10DR }  
 LOT 101 } Propellant Lot Numbers  
 LOT 102 }  
 LOT 107 }

ADDITIONAL STENCILLING TO INDICATE CHARGES DESIGNED FOR SPECIAL PURPOSES

FIG.42



- (a) Stencilling on Q.F. cartridges (separate loading) (Fig. 41) - Cases are stencilled as follows:-

Mark of the filled cartridge.

In new designs of Land Service cartridges the model number will be stencilled after or below the abbreviated letters indicating the type of the cartridge and will replace the mark of the assembled cartridge previously used to identify the design e.g. PRAC L2A9.

Propellant identification letters, shape letters and size figures.  
Propellant lot number or numbers. This may be prefixed by the letter "C" for a composite lot in Naval Service or suffixed by the letter "R" for a re-worked lot in both Naval and Land Service.  
Recognized mark or initials of the filler.  
Date of filling (month and year).

- Bags containing sectioned or incremental charges are marked as follows:- (Fig. 41)

Mark of filled cartridge.  
Calibre.  
Nominal charge weight.  
Propellant identification letters, shape letter and size figures.  
Lot number of propellant.  
Recognized mark or initials of the filler.  
Date of filling (month and year).

The type letter or letters of the bag and the recognized initials of the contractor making the empty bag are printed as close as possible to the mouth of the bag, so that they are hidden by the choke or seam when the bag is closed after filling.

- (b) Details of the type of charge may be stencilled on the base of the cartridge case. On cases where the base does not provide sufficient room for stencilling, the side of the case is utilized for all or part of the stencilling.

Stencilling on Q.F. fixed and separate loading cartridges to indicate charges designed for special purposes (Fig. 42)

SUPER	indicating	super charge.
SV	"	super velocity charge.
HV	"	high velocity charge.
RED	"	reduced charge (Land Service).
PRAC. RED	"	practice reduced charge.
CLEARING	"	clearing charge.
BLANK	"	blank charge.
PAPER	"	charge for paper shot.
BREAK-UP	"	charge for break-up shot.

- (c) B.L. cartridges (Fig. 43) - The charges of B.L. cartridges are contained in undyed fabric bags on which stencilling and printing are the usual means of identification. Fabrics which have been treated with D.A.N. (dinitro-alpha-naphthol) may assume a yellow colour. The following are the normal markings which are stencilled in printer's black ink. Red ink may be used to indicate special markings:-

Mark of the filled cartridge and details of igniter where applicable.  
Calibre and (if possible) the mark of gun with which the cartridge is to be used.  
Nominal charge weight.  
Propellant identification letters, shape letter and size figures.  
Lot number of propellant. This may be suffixed by the letter "R" for a re-worked lot.  
Recognized mark or initials of the filler. A fraction (including the fraction of the full charge), i.e. 1/2.  
Number of charge, e.g. "Charge ONE".  
Date of filling (month and year).

Where a certain charge consists of a lower charge plus an increment, the "CHARGE" is printed as in the preceding sub-para. The number of the charge, e.g. "TWO" is printed on the increment in such a position that when the two are laced together, the word "CHARGE" is in alignment with the charge number.

**EXAMPLES OF IDENTIFICATION MARKINGS ON B.L. CARTRIDGES**

FIG. 43

CARTRIDGE, B.L. 4-5in 2lb. 15oz. Cordite W.M. 061 to M. of F. Design D2(L)463/GF/2



End view showing markings on closing disc

**KEY TO STENCILLED MARKINGS**

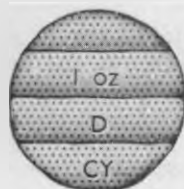
MK 2 Mark of filled Cartridge  
 4-5 BL GUN Calibre and (if applicable) the Mark of gun with which cartridge is to be used  
 2LB 15OZ Nominal Weight of Charge  
 WM 061 Propellant Identification letters and Size figures

Marked on REVERSE side of bag (as example below)

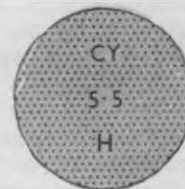
LOT 101 Propellant Lot Number  
 CY Recognized Mark (or Initials) of Filler  
 5/55 Date of Filling (month and year)

CARTRIDGE, B.L. 5-5in. 4lb. 12oz. Cordite N.Q. 050 to M. of F. Design DD(L) 16776

End view showing markings on Initiating Igniter



End view showing markings on closing disc



**KEY TO STENCILLED MARKINGS**

MK 1 Mark of filled Cartridge  
 5-5 Calibre and (if applicable) the Mark of gun with which cartridge is to be used  
 2LB 15OZ Nominal Weight of Charge of this portion  
 1LB 13OZ Nominal Weight of Charge of Initiating Igniter  
 NQ 050 Propellant Identification letters and Size figures  
 1 OZ Nominal Weight of Charge of Initiating Igniter

LOT 101 Propellant Lot Number  
 CY Recognized Mark (or Initials) of Filler  
 5/55 Date of Filling (month and year)

CARTRIDGE, B.L. 5-5in. 12lb. 9oz. Cordite N/S 164-048 to M. of F. Design DD(L) 16407

End view showing markings on initiating Igniter



**KEY TO STENCILLED MARKINGS**

MK 1 Mark of filled Cartridge  
 5-5 BL GUN Calibre and (if applicable) the Mark of gun with which cartridge is to be used  
 12LB 9OZ Nominal Weight of Charge  
 N/S 164-048 Propellant Identification letters, Shape letters and Size figures  
 2 OZ Nominal Weight of Charge of Initiating Igniter

Marked on REVERSE side of bag (as example above)

LOT 101 Propellant Lot Number  
 CY Recognized Mark (or Initials) of Filler  
 5/55 Date of Filling (month and year)

Other markings on cartridge bags.

The word SUPER indicating super charge.

The number of the lower charge is printed across the bottom of the bag, opposite to the end, on which the initiating igniter is affixed.

The words NOT TO BE FIRED SEPARATELY are printed on the bottom of the charge increment when these can only be fired in conjunction with the lower charge.

The type letter or letters of the bag and recognized mark or initials of contractor making the empty bag are printed as close as possible to the mouth of the bag, so that they are hidden by the seam when the bag is closed after filling.

- (d) Igniters (Fig. 43) - The outer worsted cloth disc of all igniters is dyed red. When the igniter is not manufactured as an integral part of the cartridge bag the following details are stencilled or printed in printer's black ink:-

Type letter or number and/or weight in ounces of gunpowder.  
Recognized mark or initials of filler.

When the type letter is not used, e.g. in the case of igniters made integral with the cartridge bag, it is replaced by the details of the calibre of the weapon and the weight of the charge.

- (e) B.L. drill cartridges - B.L. drill cartridges are filled inert and are normally made up, as regards material, shape and identification markings to resemble externally the particular Service cartridge they represent.  
In addition to the details as stencilled on the Service equivalent being reproduced, the word "DRILL" is stencilled in bold type on each portion or increment of the charge and on the igniter.
- (f) Q.F. drill and dummy cartridges - The word(s) "drill" or "dummy", together with the type of round (as applicable) is stencilled on the side of the case in white lettering where the store is coloured black or made from material left in its natural colour or in silver nitrate in the case of cartridges made up with brass cases.
- (g) Q.F. blank, and paper shot cartridges - The word BLANK is stencilled (if not already stamped) on the base and on the side of the cartridge case in silver nitrate in large type. Paper shot cartridges have the word "PAPER" stencilled on the base and the words PAPER SHOT stencilled on the side of the cartridge case. In addition, the following is stencilled in the position shown:-

Base and side of case  
Mark or model number of complete assembled cartridge.

Side of case  
Nominal charge weight.  
Propellant identification code, size and lot number.  
Recognized mark or initials of filler and date of filling (Month and year).

- (h) Charges for Q.F. and B.L. blank cartridges - Blank charges may be of two types, i.e. charges consisting of gunpowder or of cordite. The gunpowder charges are normally contained in a silk-cloth bag which has the following particulars stencilled or painted in black lettering around the circumference.

Mark of charge.  
"BLANK".  
Nature of equipment(s) for which approved.  
Weight and nature of gunpowder.  
Recognized mark or initials of filler.  
Date of filling (month and year).  
Lot number of gunpowder.

363. Stampings - Stampings are used for recording particulars of the empty case on the base of metal cases of Q.F. cartridges, on cartridge clips and on metal components of cartridges. They are also used on the bases of cartridge cases to denote the number of times they have been filled, fired or re-formed.

Particulars of the empty case normally consist of the following:-

Calibre and mark of gun or calibre.

The mark of gun is only included when the cartridge is peculiar to a particular mark of gun.

Mark or part number of empty case.

Lot number of empty case.

The word "BLANK" when cases are specifically sentenced or manufactured for firing blank only.

The word "CLEARING" when cases are specifically sentenced or manufactured for firing clearing charges only.

Year of manufacture.

Contractor's recognized mark or initials.

Examiner's work mark.

Acceptance mark.

Repaired cases are stamped with the monogram of the repairer within a rectangle.

In Lend Service, when a case is filled for the first time with a charge other than blank, the letter "F" or "R" indicating full or reduced charge as applicable is stamped on the base.

Each subsequent refilling is indicated by an additional "F" or "R" with the monogram of the factory in which the case was re-formed stamped above it.

In the event of the filling being removed instead of being fired, the "F" or "R" corresponding to the filling is barred out.

364. Q.F. drill or dummy cartridges - The calibre, type and mark together with the word(s) DRILL or DUMMY (as applicable) and the initials or recognized monogram of the manufacturer and year of manufacture are stamped or engraved on the base of the cartridge case.

#### ADDITIONAL MEANS OF IDENTIFICATION

365. The following will be identified as shown:-

- (a) All Q.F. blank cartridges have a red worsted cloth disc fitted in the mouth of the cartridge case. It is shellacked to the outer surface of the retaining cup, if such is positioned in the mouth of the case, or where the cup is positioned well down inside the case, the red disc is affixed to the inside edge of the mouth of the case.
- (b) Q.F. clearing cartridges have a blue worsted cloth disc shellacked to the outer surface of the retaining cup positioned in the mouth of the cartridge case.
- (c) Q.F. paper shot cartridges (for proof of mountings) have a green paper disc shellacked to the outer surface of the retaining cup positioned in the mouth of the cartridge case, or alternatively the outer surface of the retaining cup may be painted light green.

In all cases the word BLANK, CLEARING or PAPER (as applicable) is clearly marked on the disc.

#### MORTAR CARTRIDGES

366. Mortar cartridges are identified by stamping, stencilling or printing.

- (a) Primary cartridges:-

Printing on the side of the case:-

Calibre and nature of mortar.

Mark of cartridge.

Propellant identification letters, shape letter and size figure.

Nominal charge weight.

Recognized mark or initials of the filler.

Printing on the closing disc:-

Lot number.

Date of filling (month and year).

(b) Augmenting cartridges - These are usually contained in celluloid cases on which it is not possible to stencil or stamp, therefore labels are used and inserted in the transparent case. They are of white paper, 1.1/8 inches by 3/4 inch with the following particulars printed in black:-

- Mark of filled cartridge.
- Propellant identification letters, shape letter and size figures.
- Identification letter and number of the label.
- Lot number of propellant.
- Nominal charge weight.
- Date of filling (month and year).
- Recognized mark or initials of the filler.

## Chapter 12

### Identification Colours and Markings

#### Section 3. Projectiles, Fuzes and Tracers

#### Important

It should be noted that the markings described in the following paragraphs, vary in certain cases considerably from past practice, and naturally stores of past and present manufacture will at times exist together with different markings. Examples of projectiles marked according to the older methods of identification will be found illustrated in Regulations for the R.A.C.S. Volume 4 Pamphlet No. 1 Part 3.

#### PROJECTILES

367. Markings on projectiles may be divided into two main classes:-

##### Stampings

Distinctive basic body colours, stencilling, coloured rings, bands and stripes and symbols applied by paint.

368. Stamping generally indicates facts concerning the empty projectiles and its inspection. The type of shell, or filling, is sometimes shown by stamping so that in the event of the paintings becoming obliterated the projectile can be identified.

The position of stampings is as follows:-

On projectiles used for separate loading ammunition on the base.

On projectiles used for fixed ammunition on the body above the driving band.

The following stampings will be found:-

Calibre and mark or part number of empty projectile.  
Manufacturer's initials (or recognized mark) and date of manufacture.  
Lot number of empty projectile.  
Projectile material i.e.,

CS	indicating	Cast steel
FS	"	Forged steel
BS	"	Bored from billet of steel
CI	"	Cast iron
SS	"	Semi-steel
SMK	"	Smoke shell
P SPL	"	Special practice projectile



369. Method of colour identification and markings - The basic body colours indicate the type of the projectile, as follows:-

Body	Colour of Stencilling	In Land Service - Full Title	Abbreviation
Buff, middle	Black	Shell:- High explosive High explosive anti-tank (shaped charge) High explosive squash head	HE HEAT HESH
Green, Brunswick, Light	Black	Shell, smoke:- screening and coloured	SMK
Light grey	See para. 372	Shell:- Chemical	CHEM
Red oxide	Black	Shell:- Incendiary	INCDY
White	Black	Shell:- Star Illuminating Flare	- - FLAR
Black	Red, signal	Shot:- Practice shot	
Black	White	Practice shell:- Drill Paper shot Radar echo shell Miscellaneous	

NOTES:- 1. Combinations of the above basic colours are employed on stores of composite nature, e.g. practice ammunition with H.E., smoke or chemical filling.

2. Basic body colours for mortar bombs - With the exception of mortar bombs filled H.E., the same colour identification as approved for distinguishing the various types of projectiles is used. In the case of H.E. filled bombs the body is phosphated and afterwards stove varnished, the resultant finish having no colour identification significance. On streamline bombs the head and on cylindrical shaped bombs the head and space between the guide bands only is painted; the remainder of the bomb body and tail unit being left phosphated and stove varnished only i.e., without any identification colour being applied over it.

370. Coloured rings, bands and stripes - These are placed over the basic body colour to indicate:-

- (a) That the projectile contains an active agent.
- (b) The type of charging of chemical shell.
- (c) Special features.

371. Ring indicating store contains an active agent - This is red usually 1/2 inch in width and is painted on the ogive of the projectile (Fig. 44 ex. A). It denotes that the store contains an active agent, (explosive, chemical or otherwise) and is normally classified for storage, transit and handling in a Government Explosive Group. This marking is also used on shot fitted with tracers and practice shell filled with flash pellets.

A plain ring indicates suitability for issue and storage under all climatic conditions.

A cross-bar-cross red ring denotes a limited life in hot or cold climates. It is a cautionary warning denoting that the store should be frequently inspected and/or tested to confirm its continued serviceability (Fig. 44 ex. B).

In addition to this symbol, when the store is restricted in transit and storage to below or above a specified defined temperature, the critical temperature figures enclosed in a rectangle preceded by the letters TSL (denoting "transit and storage temperature limitation") and the words "NOT ABOVE" or "NOT BELOW" (as applicable) will be stencilled in red on the body of the store. (Fig. 44 ex. B).

e.g. TSL NOT ABOVE 120F (actual temperature figure as applicable)  
or  
TSL NOT BELOW -25F " " " " "

A hatched ring denotes restrictions of issue and storage to temperate climates only (Fig. 44 ex.C)

372. Ring(s) indicating type of charging of chemical shell - The basic body identification colour is grey and the type of charging is classified by its tactical use:-

Green ring(s) and green stencilling indicate a casualty producing agent. Red ring(s) and red stencilling indicate a harassing agent.

One coloured ring indicates a non-persistent and two rings a persistent agent.

"UV" stencilled on certain older chemical projectiles indicates that the cavity is unvarnished.

Standard width of ring(s):-

4 inch calibre and above - 1 inch wide with 1 inch between rings if two are used.

below 4 inch calibre      1/2 inch wide with 1/2 inch between rings if two are used.

Standard position of ring(s):-

The first ring begins approximately 1/3 of the distance down from the shoulder of the projectile.

373. Rings, bands and stripes indicating special features - The standard width for coloured rings is:-

Projectiles 6 inch calibre and above	... ..	2 inches
Projectiles below 6 inch to 3 inch calibre	... ..	1 inch
Projectiles below 3 inch to 2 inch calibre	... ..	1/2 inch
Projectiles below 2 inch to 1 inch calibre	... ..	1/4 inch

Light brown ring - (Fig. 44 ex D) placed above and adjacent to the red filling ring indicates a cast iron or semi-steel projectile. This includes cast iron practice and shot practice flathead. The width of the ring will be the same as that for the red filling ring.

Black band (Fig. 44 ex E) - extending from the rear of the driving band, half-way to the base, indicates a projectile of different nominal weight from normal, fired from the same gun but requiring a different charge i.e. 5.5 inch (80 lb. projectile).

White ring(s) (Fig. 44 ex E) - A 1/2 inch wide white ring placed in front of and adjacent to the driving band indicates that the projectile is fitted with a driving band of abnormal design or material.

Yellow ring - a broken yellow ring, half standard width, painted below the yellow band (denoting a practice projectile) with half standard width of the basic body colour between the two rings, indicates a break-up projectile.

Yellow band (Fig. 44 ex D) 1 inch in width for projectiles below 3 inches calibre and 2 inches in width for projectiles above 3 inches calibre, painted just below the shoulder indicates a practice projectile and certain inert projectiles.

374. Coloured discs and circles

(a) Green disc and green circles - The inclusion of a red phosphorus smoke box in H.E. and chemical B.E. shell was, in the past, indicated by two green discs, approximately 1 inch diameter, diametrically opposed, painted on the ogive of the shell (see (i) below). The inclusion of a TNT/AL smoke producing pellet in H.E. shell is indicated by two green broken circles approximately 1 inch internal diameter with 1/2 inch letter T in the centre also in green, stencilled diametrically opposed, on the ogive of the shell. (Fig. 44 ex.F)

(i) The inclusion of a red phosphorus smoke box in H.E., and chemical B.E. shell was indicated by two green discs diametrically opposed, painted on the ogive of the shell. On H.E. shell an "A" stencilled in black on the discs denoted an aluminium box, "B" a bakelite box whilst the absence of a letter on the disc indicated a steel box. These letters, however, were not used on chemical B.E. shell because only a bakelite type of box was used. Approval has now been accorded for red phosphorus smoke boxes to be removed from all stocks of both natures of shell.

(ii) A number of H.E. shell fitted with a TNT/AL smoke producing pellet will be found in the Service with two green discs with a "T" in black super-imposed, stencilled diametrically opposed, on the ogive. This marking has now been superseded by green broken circles with the letter "T" in the centre also in green.

(b) Aluminium discs (Fig. 44 ex D) - The inclusion of a flash producing pellet is indicated by two aluminium coloured discs approximately 1 inch diameter, diametrically opposed, painted on the ogive of the projectile.

# COLOURED RINGS, BANDS AND STRIPES, ETC., ON PROJECTILES

FIG 44

**A**

CONTAINS ACTIVE AGENT

Suitable ALL climatic conditions



RED filling ring (plain)

**C**

CONTAINS ACTIVE AGENT

Suitable for TEMPERATE climates ONLY



RED filling ring (hatched)

**B**

CONTAINS ACTIVE AGENT

LIMITED LIFE In hot or cold climates with TRANSIT and STORAGE temperature LIMITATION

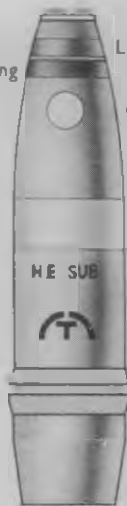


RED filling ring (cross-bar-cross)

RED stencilling

**D**

PRACTICE projectile



RED filling ring

LIGHT BROWN ring

ALUMINIUM coloured discs

YELLOW band

HE SUB

H.E SUBSTITUTE composition marking

TRACER symbol

**E**

ABNORMAL for driving band and nominal weight



WHITE ring

BLACK band

**G**

UNIVERSAL CAVITY design and WEIGHT MARKING



Two BLACK strips

+2 WEIGHT marking

**F**

SMOKE PELLETT fitted



GREEN symbol in GREEN broken circle

**H**

DRILL projectile



Body painted BLACK

DRILL WHITE stencilling

375. Coloured stars - A star of the appropriate colour (as applicable) denotes the presence of a star filling. Two stars of the appropriate colour (as applicable) positioned one above the other denotes a change colour star unit, the colour of the top star indicating the colour of the star which appears first on ejection. A number in the same colour and positioned to the right and adjacent to the star denotes the number of stars present. The letter "M" or "MULTI" immediately below the star denotes the presence of more than two star units when the exact number is unimportant. The numeral or letter(s) (as applicable) are stencilled in not less than 1/2 inch bold type.

The letter "S" in the same colour and positioned immediately below the star denotes a signal success.

The letter "P" in the same colour and positioned immediately below the star denotes the star is suspended from a parachute. The mark of the parachute (where applicable) is added after the letter e.g. "P6".

The letters "S" and "P" (as applicable) are stencilled in not less than 1 inch bold type.

The abbreviated code identifying the particular star composition is stencilled in black on the body of the shell.

NOTE:- An exception to the above occurs in the case of shell which eject an illuminating or signal (White) star, where because the basic body colour of the shell is white, the star symbol is stencilled in black. The letter "P" followed by a code number indicating that the star is suspended from a parachute, will if applicable, be stencilled immediately below the star. (Fig.47).

376. Shell with universal cavity - Land Service shell with an exploder cavity suitable for proximity (V.T.) fuzes are distinguished by two 1.1/2 inch vertical black stripes diametrically opposed, painted on the nose. They are painted over the rings (Fig.44G). To avoid overpainting the ring(s) may be positioned approx. 1.1/2 inches below the lip of the shell so that the stripes terminate just above them.

377. H.E. shell suitable for fuzeing without additional exploding - Certain Field Branch Artillery shell filled H.E. with 2 inch fuze-hole, are issued with the top exploder in position. When such shell are issued plugged, the head of the plug, is painted light blue. (Fig. 45).

#### STENCILLING (Figs.45 to 49)

378. Calibre and mark of ordnance - The calibre, identification letters and mark of the ordnance is stencilled above the type and mark of the projectile. The identifying letters approved are "H" for howitzer and "G" for gun e.g.:-

5.5 IN G                      7.2 IN.H                      3.7 G MK.6

The mark of the ordnance is omitted where the projectiles are suitable for firing in all marks of the same nature of ordnance.

In future, when new equipments are introduced, the model number followed by the letter A and a serial number will replace the "mark" previously used to identify the particular equipment i.e., L2A1.

379. Type and mark of projectile - The type and mark of the projectile is stencilled below the calibre, identification and mark of the ordnance, e.g.:-

HE MK.1	BE SMK MK.1
AP MK.1	COL SMK HE MK.2
	RED ( or colour as applicable)

In future, when new designs of projectiles are introduced, the model number followed by the letter A and a serial number will be stencilled after the abbreviated letters indicating the type of the projectile and will replace the mark previously used to identify the design e.g.:-

SMK L2A1  
CANSTR L6A1

For new designs of rounds of fixed Q.F. ammunition, the model number followed by the letter A and a serial number will be omitted from the particulars on the projectile and will be replaced by the part number allocated to the filled projectile. In such instances the model number e.g. "L13A1" of the complete assembled round will be stencilled together with the type on the base of the cartridge case or in such other position as may be approved e.g.:-

AP	CANSTR	HE
L12A1	L9A1	L4A1

380. Type of filling - The exact type of filling H.E., Smoke, etc., is indicated by abbreviations or code letters and numbers. A comprehensive list of codes for H.E. fillings is given in Appendix D while the list of codes of smoke, illuminating, etc., compositions is given in Table 2 Section 2 Part 1 of the Joint Services Ammunition and Ammunition Package Markings Handbook.

Examples:-

A mixture is indicated by an oblique stroke e.g., RDX/TNT 1 indicating a mixture of RDX and TNT of certain grades and in certain proportions.

A composite filling as opposed to a mixture is indicated by a plus sign e.g., 808 + PEN 3.

PA are the code letters indicating a FN 443 smoke composition filling.

The abbreviations, code letters and numbers are stencilled twice, diametrically opposed, on projectiles 6 inch calibre and above, and once on others.

381. Method of filling details - Prior to 1945 the design number of the method of filling was stencilled on the body of the shell. After 1945 a method of filling code was adopted. Under this code the information and particulars of the filler and date is stencilled in a single horizontal line around the ogive of the projectile. It is called the "one-line-code".

Example:- L10 CY 11/55 where:-

L	is for Land Service.
10	is the code number of the method of filling.
CY	is the filling contractor's initials or recognised mark.
11/55	is the date of filling (month and year).

The code number of the method of filling is governed by the details of the initiating system which in H.E. projectiles, for example, has the following main variables:-

Steel or paper exploder containers.  
Depth of cavity.  
Nature, number and size of exploders or serial number of the tracer, etc.

On smoke projectiles, the code number indicates details of the gunpowder burster and its filling, number and arrangement of the smoke composition containers.

The complete code is kept by the Inspectorate of Armaments. The main feature of the method of filling design corresponding to the code markings will be available to the Service in Regulations for the Army Ordnance Services, Volume 4.

NOTE: With the adoption of the new "L" model numbering system for separate loading projectile nomenclature, the "one-line-code" previously used to denote the type of filling will be dispensed with, as particulars relating to the nature and variations in the method of filling will be identified by the model number allocated to the store.  
With projectiles which are components of Q.F. fixed rounds, a filled part number will replace the model number referred to above.

382. Weight markings - stencilling of (Fig. 44 ex.G).

Weight markings are applied in accordance with a "unit system" to Land Service separate loading, shell, except Q.F. 25 pr. shell, star shell, smoke shell, chemical shell and flare shell, the units being based on the accuracy requirements of each equipment.

The weight is the actual weight of the filled shell less the weight of the plug but including the weight of the standard fuze (and exploders) approved for use therewith. The fact that the shell may be issued plugged has no connection with the weight limits stencilled on it.

Projectiles within the normal dead weight limits of the range table standard are marked with an "O". Where the weight is not within these limits, i.e. plus or minus, the shell is marked with a numeral, prefixed by a plus or minus sign (e.g. +1 or -1) to indicate, in terms of units, the variation of weight from the normal. The value of the weight unit varies with the calibre, and may also vary according to the role of the equipment (e.g. Coast Artillery weight units normally indicate finer variations than those used in Field Army Artillery). Dead weight limits are also finer for Coast Artillery projectiles.

The value of a unit in terms of weight is given in the range table in which the correction columns are headed to indicate corrections corresponding to a variation of one weight unit.

Flare shell, smoke shell, chemical shell and star shell are not weight marked, the first because the weight is adjusted during manufacture, and the others because accurate ballistics are not so important as for other types.

The reader should refer to the appropriate range table for the value of the weight unit in connection with any given shell.

















383. Fuze details - The marking "FZD LOT", followed by the lot number, is stencilled on base fuze shell.

When a projectile which is issued, plugged, to the Service can be used with one type of fuze only, the following details are stencilled on the body:- "USE No. .... FUZE".

384. Series number - The serial number stencilled in a ring on the ogive of projectiles relates to the filled series for H.E. smoke, flare, star and chemical shell and practice projectiles and the filled tracer or tracer composition series for shot.

In addition, the body charging "lot" number of smoke and chemical shell (liquid charged) is also stencilled on the body.

385. Markings on shell body relating to tracers (Fig. 44D) - Projectiles prepared for or fitted with a tracer, in addition to the usual distinctive markings, have the following symbols stencilled on the body. They are stencilled in red on projectiles painted a black basic body colour and in black on other basic body coloured projectiles.

PREPARED FOR	FITTED WITH	PREPARED FOR	FITTED WITH
 TRACER	 TRACER	  TRACER IGNITER	  TRACER IGNITER (SELF - DESTROYING)
 TRACER FUZE	 TRACER FUZE	 TRACER (DARK IGNITION)	 TRACER (DARK IGNITION)
 IGNITER	 IGNITER (SELF - DESTROYING)	  TRACER IGNITER (DARK IGNITION)	  TRACER IGNITER (DARK IGNITION, SELF - DESTROYING)

X TIME TO SELF - DESTRUCTION IN SECONDS

386. Coloured flare or smoke projectiles (Fig. 46 and 47) - Projectiles filled with coloured smoke compositions have the colour "GREEN", "YELLOW", "RED", etc., (as applicable) stencilled in white, while projectiles filled with coloured flare compositions have the colour (as applicable) stencilled in black. Initial letters are not used and the word denoting the colour is stencilled in bold type and is twice as large as the other details stencilled on the body.

387. Projectiles with inert fillings - Projectiles having inert fillings will, in future, have the nature of the filling, i.e., SAND, SALT, WEIGHTED, etc., stencilled immediately below the yellow band (denoting practice projectile) instead of these words being superimposed on the band as formerly.

Where such projectiles are assembled with tracers, a gunpowder charge, flash pellets, etc., a plain red filling ring will be painted around the ogive.

Projectiles filled with H.E. substitute composition will, in future, have the abbreviation "HE SUB" stencilled on the body immediately below the yellow band. (Fig. 44D). The abbreviation "HES" previously used and which was superimposed on the yellow band will no longer be used.

Where projectiles filled H.E. substitute composition are assembled with tracers, a gunpowder charge, flash pellets, etc., a plain red filling ring will also be painted around the ogive. (Fig. 44D).

Where the projectile is restricted to firing with a reduced charge and must not be fired with a full charge, the abbreviation "RED" (denoting reduced) will be stencilled immediately above but adjacent to the yellow band (denoting practice projectile).

The words, code or abbreviations referred to above will be stencilled twice on projectiles 6 inches and above once on others, and will be in the same size type and colour as the other main details stencilled on the body.

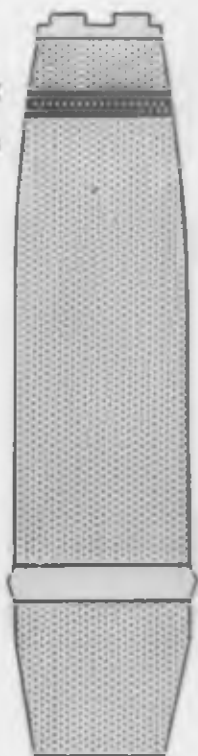
TYPICAL IDENTIFICATION MARKINGS FOR H.E. FILLED SHELL

FIG. 45

KEY TO BASIC BODY PAINTING

RED filling ring or cross-bar-cross

Body painted BUFF



CODE L.7

to M of F Design D2 (L) 554/GF/229

WITH UNIVERSAL CAVITY

BLUE plug

Two BLACK stripes

BLACK stencilling



MARKINGS ON REVERSE SIDE

KEY TO STENCILLED MARKINGS

25 PR G ... Calibre and Identification Letter of Ordnance

HE MK I .....Type and Mark of Projectile

RDX/TNT.I. Nature of Filling code abbreviation

(123).....Filled Series Lot Number

L7 CY 3/57..One line code for Method of Filling

CODE L.7

to M of F Design DD (L) 18851



MARKINGS ON REVERSE SIDE

KEY TO STENCILLED MARKINGS

25 PR G ..... Calibre and Identification Letter of Ordnance

HE MK I .....Type and Mark of Projectile

RDX/TNT.3 } ...Nature of Filling code abbreviation  
AML 2

L7 CY 11/50 } ...One line code for Method of Filling  
L6 CY 1/51

(456) (789).....Filled Series Lot Number

CODE L.6

to M of F Design DD (L) 18171



MARKINGS ON REVERSE SIDE



Painted GREEN, Indicates Smoke Pellet fitted

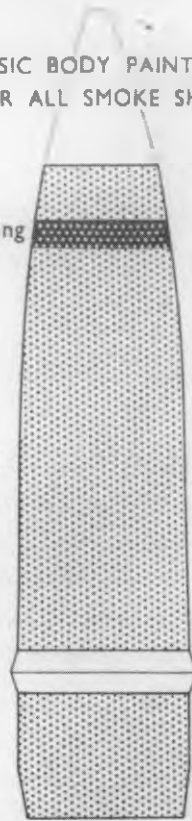
X-X-X- indicates limited life in hot or cold climates

TYPICAL IDENTIFICATION MARKINGS FOR SMOKE SHELL

KEY TO BASIC BODY PAINTING FOR ALL SMOKE SHELL

RED filling ring

Body painted GREEN

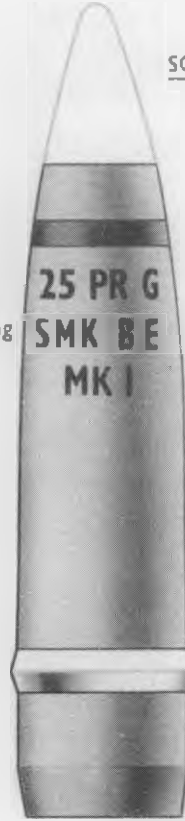


SCREENING SMOKE

CODE L 33 to M of F Design D2 (L) 1528/GF 135

BLACK stencilling

25 PR G  
SMK BE  
MK I



MARKINGS ON REVERSE SIDE

COLOURED SMOKE

CODE L 33/4 to M of F Design D2 (L) 1528/GF 135

BLACK stencilling

25 PR G  
COL SMK BE  
MK I

WHITE stencilling

RED



MARKINGS ON REVERSE SIDE

KEY TO STENCILLED MARKINGS

25 PR G Calibre and Identification Letter of Ordnance

SMK BE } Type and Mark of Projectile  
MK I }

L33 CY 3/55 One line code for Method of Filling

GE Code denoting Main Filling composition of Smoke containers

(123) Filled Series Lot Number

25 PR G Calibre and Identification Letter of Ordnance

COL SMK BE } Type and Mark of Projectile  
MK I }

RED Colour of smoke produced (or GREEN, BLUE or YELLOW)

L33/4 CY 5/55 One line code for Method of Filling

PN 443 Code denoting Main Filling composition of Smoke containers

(456) Filled Series Lot Number

Screening Smoke

Coloured Smoke



TYPICAL IDENTIFICATION MARKINGS FOR FLARE SHELL AND STAR SHELL

FIG. 47

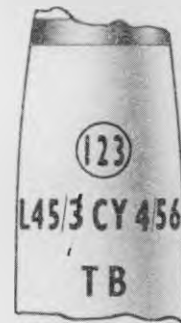
KEY TO BASIC BODY PAINTING FOR ALL FLARE AND STAR SHELL

FLARE

CODE L 45/3 to M of F Design D2 (L) 449 GF 193



BLACK stencilling



MARKINGS ON REVERSE SIDE

STAR (ILLUMINATING OR WHITE SIGNAL)

CODE L 35 to M of F Design DD (L) 17894

KEY TO STENCILLED MARKINGS

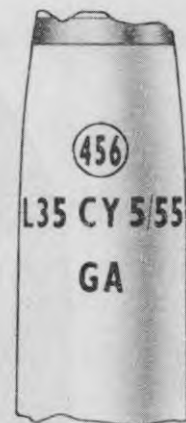
- 25 PR G..... Calibre and Identification Letter of Ordnance
- FLAR TB BE } Type and Mark of Projectile
- MK I }
- RED (or GREEN or YELLOW) Colour of flare produced
- L45 3 CY 4 56 One line code for Method of Filling
- TB ..... Code denoting main filling of Flare Container
- (123) ..... Filled Series Lot Number

Flare Shell

BLACK stencilling

- 25 PR G..... Calibre and Identification Letter of Ordnance
- STAR BE } Type and Mark of Projectile
- MK I }
- ★ ..... Indicates STAR filling
- P ..... Indicates fitted with Parachute
- L35 CY 5 55... One line code for Method of Filling
- GA ..... Code denoting main filling of Star Case
- (456) ..... Filled Series Lot Number

Star Shell



MARKINGS ON REVERSE SIDE

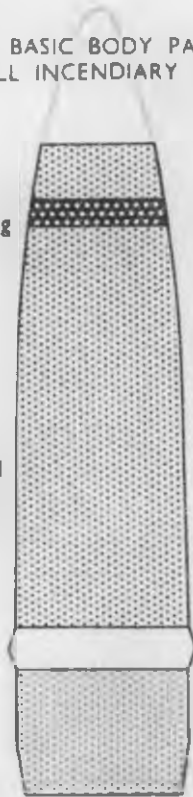
TYPICAL IDENTIFICATION MARKINGS FOR INCENDIARY SHELL

FIG. 48

KEY TO BASIC BODY PAINTING FOR ALL INCENDIARY SHELL

RED filling ring

Body painted RED OXIDE



S/L BE INCENDIARY

CODE L 33 9 to M of F Design DD (L) 11182

BLACK stencilling



MARKINGS ON REVERSE SIDE

KEY TO STENCILLED MARKINGS

25 PR G .....Calibre and Identification Letter of Ordnance

INCDY BE } .....Type and Mark of Projectile  
MK 1 }

(123) .....Filled Series Lot Number

L33/9 CY 1/55 .....One line code for Method of Filling

# .....Code denoting Main Filling of Incendiary Containers

TYPICAL IDENTIFICATION MARKINGS FOR A.P. (ARMOUR PIERCING) SHOT (WITH TRACER) FIG. 49

KEY TO BASIC BODY PAINTING

RED filling ring

Body painted BLACK



RED stencilling



CODE L 32 to M of F Design D2 (L) 1451 GF 122



MARKINGS ON REVERSE SIDE

KEY TO STENCILLED MARKINGS

25 PR G .....Calibre and Identification Letter of Ordnance

AP MK 8 .....Type and Mark of Projectile

T .....Denotes Tracer filling

(123) .....Filled Series Lot Number

L32 CY 3 55 .....One line code for Method of Filling

388. Projectiles - drill

Drill projectiles painted black have the word DRILL prominently stencilled in white, in two places on projectiles 6 inch calibre and above, and once on others (Fig.44 ex.H).

MORTAR BOMBS

389. Stencilling, rings, symbols, etc.

With the exception of mortar bombs filled H.E., which are stencilled in white lettering, all natures of bombs are identified by the same colour of stencilling, rings and symbols as approved for projectiles. These particulars are applied in relatively the same sequence but owing to the difference in shape, the actual position on the body may vary slightly.

FUZES

390. Fuze body

Stampings:-

Number and mark of fuze.  
Contractor's initials or recognized trade mark.  
Year of manufacture.  
Series lot number.  
Filling contractor's initials or recognized trade mark.  
Date of filling (month and year).  
Filled lot number.

Painting - Basic colours are not used on body or cover for identification except in the case of certain marks of No.162 fuzes approved for use in M.L. 4.2 inch mortar bombs which are distinguished by the whole of the outside of the safety cap being coloured blue, with the fuze nomenclature on top of the cap filled in red. In addition, the walls of the brass cover are painted blue.

NOTE: The red filling ring, as found for example on filled projectiles, is not used on fuzes.

391. Fuze covers

Stampings:-

Number and mark of fuze cover.  
Manufacturer's initials or recognized trade mark.  
Number and mark of fuze.  
Filling contractor's initials or recognized trade mark.  
Date of filling (month and year).  
Filled lot number of fuze.

392. Tracers

Stampings:-

Number and mark of tracer.  
Contractor's initials or recognized trade mark.  
Year of manufacture.  
Series lot number.  
Filling contractor's initials or recognized trade mark.  
Date of filling (month and year).  
Filled lot number.

## Chapter 12 Identification Colours and Markings

### Section 4. Packages

#### Important

It should be noted that the markings described in the following paragraphs, vary in certain instances considerably from past practice and naturally packages of past and current issue will, at times, exist together with different markings placed in different positions.

#### METHOD OF COLOUR IDENTIFICATION AND MARKINGS (Figs. 50 to 54)

393. Packages will normally be identified by one or more of the following:-

- Basic colour.
- Stencilling.
- Stamping, embossing and branding.
- Labels.
- Metal tags.

394. Basic body colours - Packages, with the exception of those described in para. 397 below, are painted a distinctive colour as shown:-

395. Outer packages - Wooden and ungalvanised steel outer packages are painted a basic colour of service brown except those containing chemical ammunition which are painted light grey.

396. Inner containers - Removable inner containers (including tinplate cylinders and boxes) are normally painted service brown or black, except those containing detonators which are painted red and those containing chemical stores which are painted light grey.

Tinned-plate linings (not removable). These may be painted or varnished black for protection purposes. The colour has no significance.

397. Exceptions - Packages and containers made from the following materials will not normally be painted, they may, however, carry such special identification as necessary.

- Cellulose containers (except when used as an outer package)
- Galvanised steel packages
- Packages made of:-

- Light alloy
- Resin-bonded plywood
- Fibre glass

398. Coloured bands on packages - Coloured bands have no Inter-Service significance and are reserved for special purposes and for international use as necessary.

399. Stencilling - Stencilling on packages, containers, etc., is intended to provide the user and the storeholder with all the necessary information to readily identify the contents, their filling and their Government explosive classification group, etc. These consist of:-

- (a) Quantity and descriptive nomenclature - The quantity and approved abbreviated nomenclature and mark of contents.  
In the case of B.L. and Q.F. separate loading cartridges the nominal charge weight will be shown if this is included in the approved nomenclature.
- (b) Components - Detailed information regarding components of the store.
- (c) Government explosive classification group - This will normally be applied by stencilling or by a stamp.
- (d) Operational markings - In the Land Service, additional details known as "operational markings" are used. These consist of boldly stencilled abbreviations which enable the

user in an operational area to identify quickly the store he requires. Operational abbreviations, are not used on packages containing practice, drill, dummy, instructional, blank or proof stores.

A list of approved operational abbreviations is given in para. 424.

400. Special details or symbols - Particulars of these are given in para. 403.

401. Colour of stencilling - The following colours are normally used for stencilling on packages:-

Quantity )	Golden yellow.
Nomenclature and )	(On unpainted packages black may be used if this affords greater
component details)	visibility).
Government explosive)	White on a dark basic coloured background and signal red on a light
classification group)	basic coloured background.
Safety distance category.	White
Operational markings.	"S.A.S."
Restrictive sentences and	Signal red.
temperature limitations.	

402. Position - The position of stencilling on packages depends on various factors such as:-

Operational and user requirements.	Method of stowage or stacking.
Design of package.	Particulars of contents, etc.

To avoid stencilling and/or symbols being removed or defaced in handling, stacking or stowage, these particulars should where possible, be positioned in recessed panels, or in recesses between raised panels or fluting of steel packages and cylinders and between battens of wooden packages.

The following particulars are normally stencilled as shown:-

Outer packages

On lid or top

Government explosive group classification symbol or label.  
Safety distance category.  
Operational abbreviation.  
"S.A.S." (when applicable).

On side or front

Quantity of items packed.  
Approved abbreviated descriptive nomenclature and mark of complete store.  
Quantity of inner packages, and type (where applicable).  
Lot or batch number if ammunition is batched.  
Type, size and lot number of propellant (if amm. is not batched).  
Nature of filling of shell, bombs, etc., (as applicable).  
Method of filling code (Land Service, Q.F. separate loading shell only).  
Filled series number of projectile (Land Service on packages containing plugged or  
fuzed separate loading projectiles).  
Assemblers or fillers recognized mark or initials.  
Date of assembly or filling (month and year).  
Propellant identification code.  
Approved abbreviated descriptive nomenclature, mark, lot number, initials of filler  
and year of filling of component stores, e.g.,

FZ 117-15 = 123-CY-56

PR 9-3 = 123-CY-56 (on packages containing Q.F. separate cartridges)

The following will also be stencilled when applicable:-

Tracer symbol )	as marked on projectile
Smoke box or pellet symbol )	

"DEC" denoting special decoppering rounds.

"H.V." indicating High velocity charges or rounds.

LATEST APPROVED IDENTIFICATION MARKINGS FOR STEEL BOX  
FOR SEPARATE LOADING SHELL  
TYPICAL FOR 25 PR PROJECTILES

FIG. 50

Box painted BROWN



KEY TO STENCILLED MARKINGS

ON LID

- 25 PR HE FZD 117..... Approved Operational Abbreviation
- ⑥..... Government Explosive Classification label  
(with Group Number as applicable)
- X..... Safety Distance category

ON R.H. END

- 123..... Filled Series Lot number of Shell
- GD..... Recognized Mark (or initials) of Filler
- 4-56..... Date of Filling (month and year)
- 112..... Package serial number
- 69LB..... Weight of complete package

ON FRONT SIDE

- 2..... Quantity of items packed
- SHELL 25 PR HE MK1..... Abbreviated Nomenclature and Mark of complete store
- U (WHEN APPLICABLE)..... Denotes shell filled to "Universal Cavity" design.
- RDXTNT..... Nature of Filling of Shell
- L7-GD-4-56..... One line Code-Method of Filling of Projectile
- 123..... Filled Series Lot number of Shell
- FZ 117-15..... Designation and Mark
- 231..... Lot Number
- CY-55..... Recognized Mark (or initials) of Filler and Year of filling

The above markings are applicable to boxes for H.E. shell. Boxes for Screening Smoke, Coloured Smoke, Flare, Incendiary, Star, and Chemical shell are similarly marked, but with the following differences

	Screening Smoke	Coloured Smoke	Flare	Incendiary	Star	Chemical
Colour of box	Brown	Brown	Brown	Brown	Brown	Grey
Approved Operational Abbreviation	25PR BE SMK FZD * or 25PR BE SMK PLGD	25PR SMK RED† FZD * or 25PR SMK RED PLGD	25PR FLAR GREEN‡ FZD * or 25PR FLAR GREEN PLGD	25PR INCDY FZD * or 25PR INCDY PLGD	25PR STAR FZD * or 25PR STAR PLGD	25PR CHEM Y4
Gov't Explosive Classification Group	11	11	6	11	6	13
Safety Distance Category	X	X	X	Y	X	None
Abbrev. Nomenclature and Mark	SHELL 25PR SMOKE BE MKø	SHELL 25PR COL SMOKE BE RED‡MKø	SHELL 25PR COL FLARE BE GREEN‡MKø	SHELL 25PR INCDY MKø	SHELL 25PR STAR MKø	SHELL 25PR CHEMICAL MKø

\* No. of Fuze (as applicable)

† Colour produced (as applicable)

ø Mark of Shell (as applicable)

Other markings, such as One Line Code for Method of Filling, Number and Mark of Fuze, Weight of Package, etc, vary according to the differences in contents.

Markings for Nature of Filling are a requirement for H.E. shell boxes only.

On right hand end

Package serial number	Batch number
Gross weight (lb.)	or
	Lot number and initials of filler and date of filling (month and year).

The filled lot number, initials or recognized monogram of filler and date of filling (month and year) are stencilled on package containing separate loading shell, fuzes, primers, pyrotechnics, rocket motors, etc.

The batch number, initials or recognized monogram of the assembly factory and year of assembly are stencilled on packages containing assembled Q.F. fixed cartridges, mortar bombs, assembled rockets etc.

Inner containers

When ammunition or components are packed in closed inner containers which can be removed from the outer package, each inner container is stencilled with the following particulars:-

"EXPLOSIVE", when the stores or components packed fall within one of the Government explosive classification groups. This stencilling will be in red, except for cylinders containing detonators when it will be in black. The word "EXPLOSIVE" is not applied on inner containers holding safety cartridges, primers for Q.F. cartridges, tubes or containers of a small size containing similar stores.

Quantity, nomenclature and mark of items packed, together with batch; lot or serial number, initials or monogram of filler, date of filling (month and year). This stencilling will be in the colour and size of type best suited to the particular container.

In the case of timplate containers, tin printing or transfers may be used in lieu of stencilling.

403. Additional stencilling - The following particulars will also be stencilled on outer packages in an approved position when required:-

- (a) Restrictive sentences - in signal red
- (b) Climatic and firing temperatures and restricted service life limitations

The under-mentioned particulars, when applicable, are stencilled in signal red in bold lettering on the lid or top and on the left hand side or end of rectangular packages and along the side of metal cylindrical packages:-

Climatic and temperature limitations

Outer and inner packages containing ammunition restricted to transit, issue and storage to certain climatic and temperature conditions are marked as follows:-

LIM ... indicated limited life in hot (or cold) climates. It is cautionary warning denoting the contents should be frequently inspected and/or tested to confirm their continued serviceability.

TEMP... indicating transit, issue and storage limited to temperate climates only.

In special instances, where the store is restricted in transit and storage to below or above a specified defined temperature, the critical temperature figures enclosed in a rectangle preceded by the letters TSL (denoting transit and storage temperature limitation) and the words "NOT ABOVE" or "NOT BELOW" (as applicable) replace the abbreviation "LIM" or "TEMP". e.g.

TSL NOT ABOVE [120F] (actual temperature figure as applicable)

or

TSL NOT BELOW [-25F] ( " " " " )

Where applicable the above-mentioned indications may be amalgamated, either following or underneath one another, in which case the words "NOT ABOVE" or "NOT BELOW" will be omitted.

LATEST APPROVED IDENTIFICATION MARKINGS FOR STEEL BOX WITH INNER CONTAINERS

FIG.51

TYPICAL FOR SEPARATE LOADING Q.F. CARTRIDGES

Box painted BROWN

WHITE stencilling

YELLOW stencilling

YELLOW stencilling



KEY TO STENCILLED MARKINGS

ON LID

- 25PR CART NQ..... Approved Operational Abbreviation
- ⑥..... Government Explosive Classification label (with Group Number as applicable)
- Y..... Safety Distance category

ON FRONT SIDE

- 8..... Quantity of Items packed
- CART 25 PRMK1/2... Abbreviated Nomenclature and Mark of complete store
- IN 8 CYLS..... Quantity of Inner containers
- NQ/R 014 x 048 }..... Propellant Identification letters, Shape letters and Size figures
- NQ 050 }..... Propellant Lot Numbers
- BS 512 }..... Propellant Lot Numbers
- BS 431 }
- 1 LB 14OZ 4DR..... Nominal Weight of Charge (one Cartridge)
- PR 9-4..... Designation and Mark
- 231..... Lot Number
- CY-53..... Recognized Mark (or Initials) of Filler and Year of filling
- GD..... Recognized Mark (or initials) of Assembler
- 4-54..... Date of Assembly (month and year)

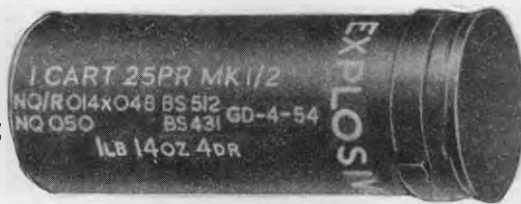
ON R.H. END

- 123..... Package serial number
- BS 512 }..... Propellant Lot Numbers
- BS 431 }
- NQ/R }..... Propellant Identification and Shape letters
- NQ }
- GD..... Recognized Mark (or initials) of Assembler
- 4-54..... Date of Assembly (month and year)
- 88LB..... Weight of complete package

ON INNER CONTAINER

- 1..... Quantity of Items packed
- CART 25 PRMK1/2... Abbreviated Nomenclature and Mark of complete store
- NQ/R 014 x 048 }..... Propellant Identification letters, Shape letters and Size figures
- NQ 050 }
- BS 512 }..... Propellant Lot Numbers
- BS 431 }
- 1 LB 14OZ 4DR..... Nominal Weight of Charge (one Cartridge)
- GD..... Recognized Mark (or initials) of Assembler
- 4-54..... Date of Assembly (month and year)

YELLOW stencilling



RED stencilling

Container painted BROWN



Firing temperature limitations

Where shown on the ammunition store, the firing temperature limitation figures in a circle is reproduced on the outer package. e.g.,



Date of expiry of or restricted Service life

Where shown on the ammunition store, the restricted Service life or date of expiry of Service life, is reproduced in red stencilling on the outer package, e.g.,

S.L. (denoting Service life) followed by the date (month and year) i.e. "SL 8/56".

404. Unsuitable for air dropping - Packages containing ammunition or explosives which are unsuitable for air dropping are marked with a red equilateral triangle, the base of which should be 1.1/2 inches approx. This symbol is stencilled on the lid or top and on one end of the package.

405. Safety distance category - This is stencilled in white in not less than 1/2 inch type above the Government explosive classification group-symbol.

The Safety distance category comprises a one or two letter code, and will be found in column 9 of the table in the "Comprehensive Classified List of Government Explosives".

406. Special ammunition stowage in freight ships - Packages containing explosives in this category which comprises all group 12 (phosphide or white phosphorus charged ammunition) all group 13 (chemical ammunition) and ammunition in group 11 charged FM or CSAM, are scheduled for special conditions of stowage in freight ships. Such packages have the sea transport code abbreviation "SAS" stencilled on in not less than 1/2 inch type in the same colour as and just below the Explosive group classification symbol. Full details of the code letter used are given in column 7 (opposite the generic transport designation of the store concerned) in the table in the "Comprehensive Classified List of Government Explosives".

NOTE: The letters "D" and "R" which appear with the code "SAS" in the Comprehensive Classified List are not stencilled on packages.

407. Dangerous and inflammable goods - All outer packages containing ammunition which, because of the nature of its filling or charging, are not classified for storage and transport in an explosive group, but are classified by the Ministry of Transport or British Railways as "dangerous goods", are stencilled to indicate the following particulars:-

Nature of contents (e.g., titanium tetrachloride, bromine).

Type of danger (e.g., corrosive, poisonous or inflammable).

Flash point classification of the inflammable goods within the following recognised groups:-

Those with a flash point below 73°F. and which are not soluble in water will be stencilled:-

"HIGHLY INFLAMMABLE F.P. BELOW 73°F."

Those with a flash point below 73°F. and which are soluble in water will be stencilled:-

"INFLAMMABLE F.P. BELOW 73°F."

Those with a flash point between 73°F. and 150°F. will be stencilled:-

"INFLAMMABLE F.P. BETWEEN 73°F. 150°F."

408. Shell - universal cavity - A "U" on the package indicates that it contains shell with "universal cavity" i.e., a cavity suitable for both normal and V.T. fuzes.

409. NATO symbol of interchangeability - A symbol, representing a four leaved clover, is used to guarantee, for the benefit of NATO Armed Forces, that certain ammunition is operationally interchangeable.

This symbol when stencilled on outer packages implies that the contents have been established as conforming as regards composition, make and serviceability to a model approved under the provisions laid down in a NATO standardization agreement, brought up-to-date as necessary. The stores will therefore be operationally interchangeable with ammunition of the same designation, type and calibre, which bears the same symbol, in all equipment for which such ammunition is normally used.

LATEST APPROVED IDENTIFICATION MARKINGS FOR  
WOOD BOX WITH INNER CONTAINERS  
TYPICAL FOR B.L. CARTRIDGES

FIG.52

Box painted BROWN

WHITE stencilling

WHITE stencilling



YELLOW stencilling

YELLOW stencilling



MARKINGS ON R.H. END

KEY TO STENCILLED MARKINGS

ON L.H. END

- ③ ..... Government Explosive Classification label (with Group Number as applicable)
- Y ..... Safety Distance category

ON FRONT SIDE

- 4 ..... Quantity of Items packed
- CART BL 5-5IN } Abbreviated Nomenclature and Mark of complete store
- MK.I 4TH CHARGE }
- IN 4 CYLS ..... Quantity of inner containers
- NQ/S 164-048 ..... Propellant Identification letters, Shape letters and Size figures
- BS 11210 ..... Propellant Lot Number
- GD ..... Recognized Mark (or Initials) of Filler
- 12-55 ..... Date of Filling (month and year)
- 9LB 13OZ 0DR ..... Nominal Weight of Charge (one Cartridge)

ON LID

- 5-5 CART } ..... Approved Operational Abbreviation
- 4 TH NQ/S }

ON R.H. END

- 176 ..... Package serial number
- BS 11210 ..... Propellant Lot Number
- GD ..... Recognized Mark (or Initials) of Filler
- 12-55 ..... Date of Filling (month and year)
- 86LB ..... Weight of complete package

ON INNER CONTAINER

- 1 ..... Quantity of Items packed
- CART 5-5IN } ..... Abbreviated Nomenclature and Mark of complete store
- MK.I 4TH }
- NQ/S 164-048 ..... Propellant Identification letters, Shape letters and Size figures
- BS 11210 ..... Propellant Lot Number
- GD ..... Recognized Mark (or Initials) of Filler
- 12-55 ..... Date of Filling (month and year)
- 9LB 13OZ 0DR ..... Nominal Weight of Charge (one Cartridge)



YELLOW stencilling

RED stencilling

Container painted BROWN

Position

It is stencilled in a prominent position on the face(s) of the package on which details of the contents appear.

Dimensions and colour

The dimensions of the symbol is not to be less than the height of the largest printed character used for the normal identification markings (type and/or calibre), nor is it to be larger than twice this height.

The colour of the symbol will be the same as that of the other main identification details stencilled on the same face.

Cancellation of symbol

When selecting the position and method of applying the symbol, consideration is given to the possible necessity of removing or obliterating it, should the contents cease to fulfil, at any time, the conditions implied by the presence of the symbol.

410. U.S./U.K. symbol denoting standardization design - A symbol [K] is stencilled on packages containing ammunition which is manufactured to a standardized design approved for weapons which are equipment of both the U.S. and U.K. Armed Forces.

Position

It is stencilled in a prominent position on the face(s) of the package on which the main details of the contents appear.

Dimensions and colour

The dimensions of the symbol is not to be less than the height of the largest printed character used for the normal identification markings (type and/or calibre), nor is it to be larger than twice this height.

The colour of the symbol will be the same as that of the other main identification details stencilled on the same face.

411. Part packages - When packages do not contain the full approved complement of stores, the word FRACTION (or FRAC) is stencilled in bold type in red on the lid or top and on one side.

The "quantity of items packed" where stencilled on the package is amended to agree.

412. For individual Services - Additional stencilling usually of a self-explanatory nature is sometimes applied by individual Services for a particular purpose. For example, packages of stores bearing [U] symbol may be expected to carry more or different detail and markings than their purely British Service counterparts, to meet the U.S. user requirements in addition to British requirements.

413. Stamping, embossing and branding - Empty packages have the following particulars stamped, embossed or branded by the maker:-

- Box letter, number and mark.
- Recognized initials or monogram of manufacturer.
- Year of manufacture.

On metal packages this information is embossed, on wooden packages it is stamped or branded. Cellulosic containers cannot be embossed, stamped or branded; it is therefore usual to stencil the particulars of the empty package, or to stamp or emboss the metal ends.

414. Government explosive classification group label - Packages containing stores classified for storage and transport in an explosive group may be labelled, instead of the symbol being stencilled on, with a group label carrying a group number which denotes the conditions under which the package is to be transported and stored (see Comprehensive Classified List of Government Explosives).

The Government explosive group label used in each Service is as follows:-

- Naval Service - Red on white background, with "N" to indicate Naval Service.
- Land Service - Red on white background, with "W 'D" to indicate Land Service.
- Air Service - Red on white background, with "RAF" to indicate Air Service.
- Ministry of Supply - Red on white background, with "MOS" to indicate Ministry of Supply.

LATEST APPROVED IDENTIFICATION MARKINGS FOR  
WOOD BOX WITH INNER CONTAINERS

TYPICAL FOR 4.2IN MORTAR AMMUNITION

Box painted BROWN

WHITE stencilling

MARKINGS ON  
R.H. END

WHITE  
stencilling



YELLOW stencilling

KEY TO STENCILLED MARKINGS

ON LID

4.2 MOR HE } Approved Operational  
FZD 162 } Abbreviation

ON L H END

- 8 Government Explosive Classification label (with Group Number as applicable)
- X Safety Distance category

ON R.H. END

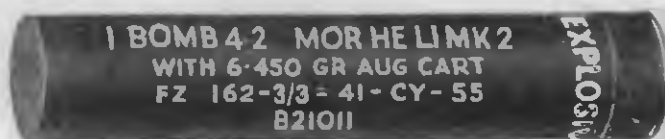
- 123 Package serial number
- B 21011 Batch Number
- 77LB Weight of complete package

ON FRONT SIDE

- 2 Quantity of items packed
- BOMBS 4.2IN MOR HE } Abbreviated Nomenclature and Mark of complete store
- LI MK2 }
- IN 2 CNRS Quantity of Inner containers
- EACH WITH 6-450 GR AUG CART } Quantity of Augmenting Cartridges and Nominal Weight of Charge (one Cartridge)
- AML Nature of Filling of bomb
- B 21011 Batch Number
- GD-56 Recognized Mark (or initials) of Assembler of bomb and Year of Assembly
- FZ 162-3/3 Designation and Mark
- 41 Lot Number
- CY-55 Recognized Mark (or initials) of Filler and Year of filling } of Fuze

ON INNER CONTAINER

Container painted BROWN



YELLOW stencilling

RED  
stencilling

- 1 Quantity of Items packed
- BOMB 4.2IN MOR HE } Abbreviated Nomenclature and Mark of complete store
- LI MK2 }
- WITH 6-450 GR AUG CART } Quantity of Augmenting Cartridges and Nominal Weight of Charge (one Cartridge)
- FZ 162-3/3 Designation and Mark
- 41 Lot Number
- CY-55 Recognized Mark (or initials) of Filler and Year of filling } of Fuze
- B 21011 Batch Number

It will normally be applied once on the lid or top of the outer package, adjacent to, but clear of the operational abbreviation (if applied).

415. Dangerous goods labels - Special labels are required to be affixed to outer packages containing ammunition classified as "dangerous goods" in the "corrosive" or "poisonous" classes. The labels of specified dimensions and colours as shown, are each marked near the top with one of the "traffic letters" "A, B, C" etc. These letters, as applicable, are shown against the "corrosive" and "poisonous" items in the "dangerous goods" listed by British Railways to indicate the labels which must be used. Packages which have contained dangerous goods in the "A" or "C" classes must also bear the "A" or "C" labels when being returned as empties.

416. Packers label - On every occasion of closing or reclosing any package containing explosives prior to sealing or resealing a packers label is:-

Inserted loose in the bottom of containers for cartridges.  
Affixed on the inside of the lid of other packages.

This label bears the initials, etc., of the operative who carried out the packing, together with the station monogram and the date of packing. It may also bear the initials or workmark of the examiner responsible for inspection. This label will be removed when the package is emptied of explosives.

417. Contents and batch labels - Contents labels usually include the details previously mentioned under "stencilling" in addition to any other information as required.

Batch labels include details relating to the components of assembled Q.F. fixed cartridges, mortar bombs, rockets, etc.

Contents labels which are affixed to the outside of inner packages, containers, or linings containing explosives will be overprinted "EXPLOSIVE" in red.

Contents and/or batch labels if used are usually affixed in a convenient position inside the outer package, and may also be used on the outside of inner packages.

418. Sealing - Every package containing explosives is sealed in such a manner that the package cannot be opened without breaking the seal.

Sealing is effected by means of:-

Station labels of white linen or muslin with two black lines, having the factory, station or depot monogram between them. These are placed on each package to indicate where the package was sealed and are affixed near the corners diagonally opposite on boxes with hingeless lids, obliquely under each fastener on boxes with hinged lids, and over the junction of lid and body of cylindrical packages and where appropriate placed over the knot of sealing tape or wire fastener. Station labels are to be completely removed when a package is opened.

Lead seals are used in conjunction with braided sealing wire in place of station labels where proper adhesion of the latter cannot be ensured. The sealing wire is passed through hasps or through appropriate lugs or holes and the seal impressed with the station monogram.

Inspection labels are similar to station labels and are similarly affixed but bear only the letters of the Inspectorate and the inspectors workmark. They denote that the contents have been dealt with and packed under inspection.

Two labels are normally used for sealing; one, the station label, and the other, an inspection label affixed by inspecting staff. In certain Government establishments two composite station cum inspection labels may be used. (In Land Service - the use of this composite label will be discontinued when existing stocks are exhausted).

419. Restricted use (Where stencilling is not adopted) - These labels indicate briefly the nature of the restriction. They may be affixed in any convenient position which does not obscure any stencilling, labelling or stamping.

420. Special identification, instructional or warning labels - These, when ordered to be used, are secured to the store or on the exterior of the package in any convenient position which does not obscure any stencilling, labelling or stamping; instructional labels are occasionally ordered to be affixed under the lid.

421. Empty explosive packages - A label is to be applied to every package which has been emptied and searched and certified not to contain any explosive matter. It is to show the station and date of emptying and is to be signed by the person who empties and examines the package; the latter is responsible that the package is entirely free from explosive. The label is to be affixed in such a manner that the package cannot be opened without tearing it and it is to be removed completely when any explosives or dangerous goods are placed in the package.

422. Treatment of labels - Particulars on labels used on explosive filled packages are to be inserted by printing or by means of rubber stamps as far as practicable, but where it is necessary to complete details in manuscript, block capitals and arabic numerals are invariably to be used. The labels are to be marked only with H.M.S.O. waterproof black drawing ink, H.M.S.O. blue black record ink or Reeves waterproof fixed Indian ink.

423. Metal tags - Metal tags for identification, warning or instructional purposes will not normally be used on packages owing to the danger of loss in transit.

424. Operational markings for Land Service ammunition packages other than S.A.A. - To permit quick and easy identification of contents the following approved operational abbreviations are stencilled in "white" on a conspicuous surface of the outer package.

The stencilling is in bold type as large as possible consistent with the size and shape of the package and never less than 1/2 inch deep.

Operational abbreviations will not be used on packages containing blank, drill, dummy, practice, instructional or proof stores.

- NOTES
- (1) In the case of B.L. and Q.F. separate loading cartridges, to avoid frequent amendments to this table, the propellant code identification letters shown in the operational abbreviations (column 2) will be changed, as necessary, to agree with the nature of the propellant shown in the main descriptive nomenclature of the particular cartridge packed.
  - (2) Differences in nomenclature (column 1) due to changes in nominal charge weights and natures of propellant will be shown in the main descriptive nomenclature of the particular cartridge concerned which is stencilled on the side of the package.

<u>NATURE OF AMMUNITION</u>		<u>OPERATIONAL ABBREVIATIONS</u>
<u>Field Artillery ammunition</u>		
Carts. Q.F. 25 pr.	2 lb. 1 oz. 12 dr. FNH	25 PR CART FNH
"	" 1 lb. 14 oz. 4 dr. NQ	25 PR CART NQ
"	" 2 lb. 1 oz. 4 dr. NH	25 PR CART NH
"	" 1 lb. 11 oz. 4 dr. WM	25 PR CART WM
"	" 2 lb. 8 oz. 0 dr. WM	25 PR SUP WM
"	" 2 lb. 13 oz. 8 dr. NQ/S	25 PR SUP NQ
"	" supercharge increment	25 PR SUP INC
"	" normal increment	25 PR INTER INC
Shell Q.F. 25 pr.	H.E. fuze	25 PR HE FZD*
"	" H.E. plugged for fuze V.T.	25 PR HE PLGD U
"	" H.E. plugged with fuze in cylinder	25 PR HE PLGD W/FZ IN CYL.
"	" B.E. smoke fuze	25 PR BE SMK FZD*
"	" B.E. smoke plugged	25 PR BE SMK PLGD
"	" smoke coloured fuze	25 PR SMK / FZD*
"	" smoke coloured plugged	25 PR SMK / PLGD
"	" flare coloured fuze	25 PR FLAR / FZD*
"	" flare coloured plugged	25 PR FLAR / PLGD
"	" star fuze	25 PR STAR FZD*
"	" star plugged	25 PR STAR PLGD
"	" incendiary fuze	25 PR INCDY FZD*
"	" incendiary plugged	25 PR INCDY PLGD
Shot Q.F. 25 pr.	AP	25 PR AP
"	" APC	25 PR APC

<u>NATURE OF AMMUNITION</u>	<u>OPERATIONAL ABBREVIATIONS</u>
Carts. B.L. 5.5 in. 9 lb. 2 oz. WM	5.5 CART 4TH WM
" " " 9 lb. 13 oz. NQ/S	5.5 CART 4TH NQ/S
" " " 4 lb. 4 oz. WM	5.5 CART 2ND WM
" " " 4 lb. 12 oz. NQ	5.5 CART 2ND NQ
" " " 12 lb. 9 oz. for 80 lb. shell	5.5 CART SUP NQ/S
Carts. B.L. 7.2 in. 7 lb. 0 oz. N/S	7.2 CART 5TH N/S
" " " 24 lb. N/S	7.2 CART 4TH N/S
" " " 11 lb. 10 oz. WM	7.2 CART 3RD WM
" " " 13 lb. 11 oz. N	7.2 CART 3RD N
<u>Mortar ammunition</u>	
Bombs M.L. 4.2 in. mortar HE fuzed	4.2 MOR HE FZD*
Cartridges M.L. 4.2 in. mortar 140 grain	CART 4.2 MOR 140 GR
" " " " 450 grain	CART 4.2 MOR 450 GR
<u>Fuzes</u>	
Fuze No. *	FUZ*
Fuze No. * Mk. /	FUZ* /
Fuze No. * with exploders	FUZ* W/EXPR
Fuze time and D.A. L1	FUZ L1
Fuze perc. base medium L10	FUZ L10
<u>Primers and Tubes</u>	
Primers percussion Q.F. cart. No. *	PRIM PERC *
" electric Q.F. cart. No. *	PRIM ELEC *
Tube percussion SA	TUB PSA

SYMBOLS USED

- \* - indicates number of store as applicable
- / - " colour as applicable
- / - " mark as applicable

FIG. 54

### LATEST APPROVED IDENTIFICATION MARKINGS FOR STEEL BOX FOR BULK PACKED FUZES

Box painted BROWN



#### KEY TO STENCILLED MARKINGS

##### ON LID

FUZ 117 ..... Approved Operational Abbreviation

Ⓟ ..... Government Explosive Classification label  
(with Group Number as applicable)

X ..... Safety Distance category

##### ON FRONT SIDE

- 12 ..... Quantity of items packed
- FUZ 117 MK 15 ..... Abbreviated Nomenclature and Mark of complete store
- IN 12 CYLS ..... Quantity of inner containers
- 534 ..... Filled Series Lot number
- CY-5/55 ..... Recognized Mark (or Initials) of Filler and Date of Filling (month and year)

##### ON R.H. END

- 123 ..... Package serial number
- 534 ..... Filled Series Lot number
- CY-5/55 ..... Recognized Mark (or Initials) of Filler and Date of Assembly (month and year)
- 49LB ..... Weight of complete package



## Chapter 13 Associated Publications

425. The attention of readers is drawn to the following publications which should be read in conjunction with this handbook:-

### CARE AND PRESERVATION

Notes on the Care and Preservation of Ammunition and Explosives in the Field. Part 1 Artillery Ammunition 1941 (Reprinted with amendments (No. 1 and 2) 1951) W.O. Code No. 7198.

### UNEXPLODED SHELL

Instructions for Practice Field Branch and Anti-Tank Artillery 1948 (as amended) W.O. Code 8308 Appendix VI gives procedure for destruction of unexploded shell.

### ACCIDENTS

Regulations for Army Ordnance Services Volume III Pamphlet 5, 1946. Contains the full procedure for reporting accidents with ammunition.

### PRINCIPLES

Artillery Training Volume III Pamphlet 1: Ballistics and Ammunition. This gives a grounding in the basic principles on all types of artillery ammunition.

### STORAGE

Ammunition and Explosive Regulations 1953. Consists of four parts which cover all aspects of depot storage, unit storage, construction of stores, ventilation and the reporting of accidents and defects. Parts 3 (The Unit Store) and 5 (Reporting of Accidents, etc.,) should be held by all Units.

W.O. Codes - Part 3: 6942. Part 5: 10446.

### PACKAGES

Regulations for Army Ordnance Service Volume 4 - Ammunition. This consists of 27 parts each covering one equipment's ammunition and ammunition packages in the greatest possible detail. W.O. Code 10035.

### ROCKET AMMUNITION

Regulations for Army Ordnance Services Volume 4 Ammunition Pamphlet 11. Part 1 - 3.5 inch Rocket Ammunition.

### TRAINING LIMITATIONS

Limitations on the use of Fuzes for Training. 1955. W.O. Code 11233. Issued annually, with fresh Code No. Should be carried by all Gunnery Staff, particularly at Practice Camps.

### AMERICAN AMMUNITION

U.S.W.D. T.M. 9-1901. Artillery Ammunition. Covers all ammunition issued for Artillery weapons, with sections on each equipment, fuzes, primers, charges, etc. profusely illustrated.

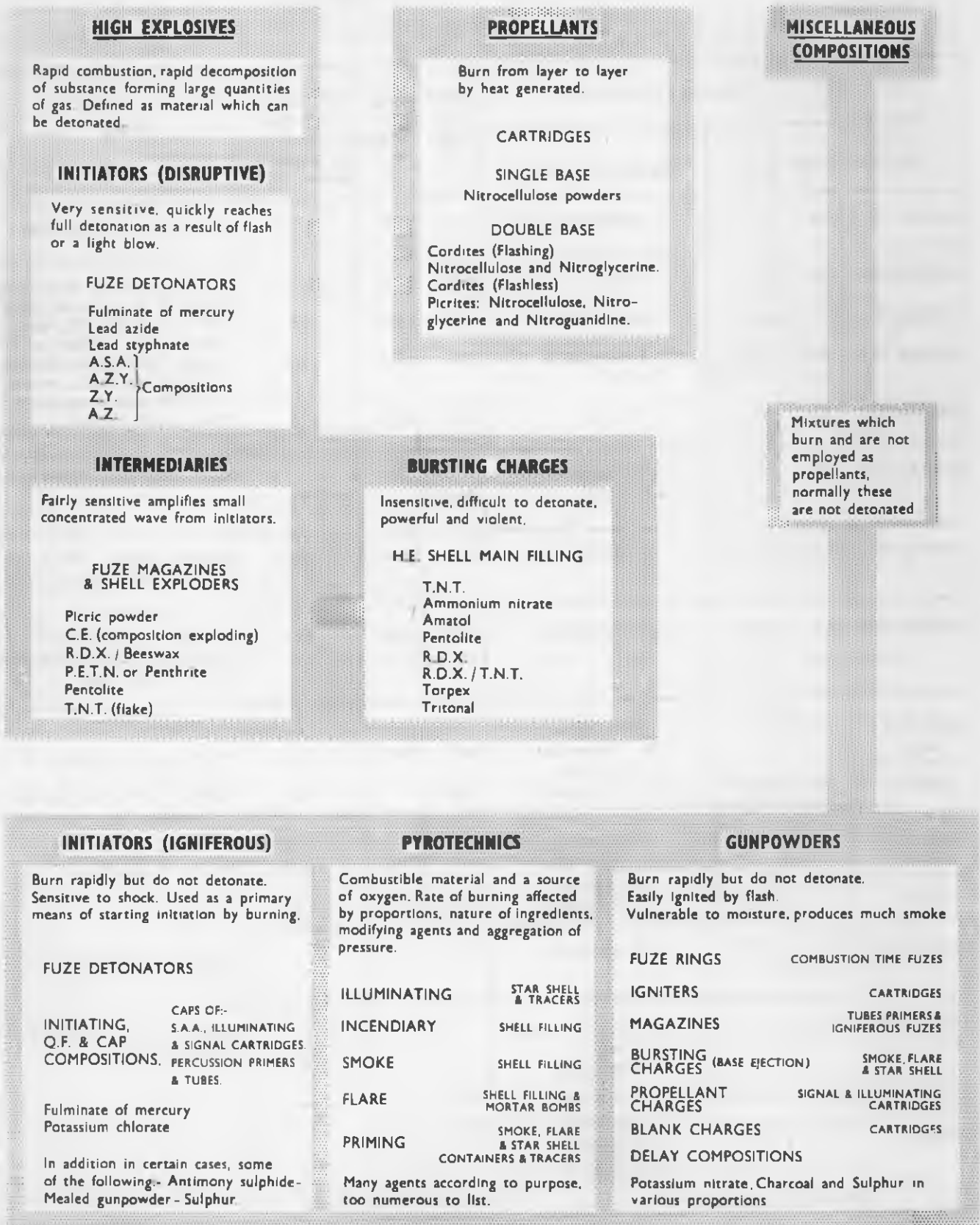
### IDENTIFICATION

Joint Services Ammunition and Ammunition Package Markings Handbook. W.O. Code 1803. Explains and illustrates the latest approved identification colours and markings of every type and nature of ammunition, components and packages.



## Appendix A

### Various types and uses of explosives





NOMENCLATURE	LEGEND OR ABBREVI.	CONSTITUENTS AND APPROXIMATE PERCENTAGES											USES			
		MERCURY FULMINATE	LEAD AZIDE	LEAD STYRNATE	CE	FEETN	TNT	POTASSIUM CHLORATE	ANTIMONY SULPHIDE	ALUMINIUM POWDER	GUNPOWDER (MEALD)	SULPHUR		POWDERED GLASS	ZED C STRAIGHTS	GRAPHITE
QF COMPOSITION	Q						36.4	54.6		3.0	3.0	3.0				Caps of percussion primers and certain SAA Obscr. bullets
Q3 COMPOSITION	Q3						54.0	40.0			6.0					Caps of percussion primers
FULMINATE COMPOSITION		80.0					20.0									Large detonators
CAP COMPOSITIONS	E1	E1	19.0				33.4	42.8		2.4	2.4					Caps of SAA and percussion tubes
	F1	F1	28.0				41.0	31.0								Certain SAA Caps
	G1	G1	27.0				32.0	41.0								
	VH2	VH2		BARIUM NITRATE		39.0	ANTIMONY SULPHIDE		5.0							
			COMPOSITION RD 1302		38.0	LEAD PEROXIDE		5.0								
			CALCIUM SILICIDE		11.0	TETRAZINE		2.0								
<p>• These compositions may be used in composite fillings of fuze detonators. (See paragraphs 107 to 110)</p> <p>∧ Proportions may vary according to use.</p>																

The reason for the inclusion of the various ingredients is as follows:-

- Aluminium - increases heat and flame
- Antimony sulphide - prolongs the flame effect
- Glass-powdered - induces friction
- Gunpowder (mealed) - diminishes the violence of the explosion
- Mercury fulminate - increases the sensitivity of the composition
- Potassium chlorate - increases the heat of the explosion
- Sulphur - diminishes the violence of the explosion
- Wax - used as dessensitizer

Notes:-

- (1) "A" and "A.1" etc., mixtures are identical in chemical composition but differ a grist size of potassium chlorate and antimony sulphide; the former mixture being the coarser. For A, B, C and D all the chlorate/sulphide must be retained on a 170 mesh sieve. For A1, B1, C1 and D1 approx. 75 per cent. of the chlorate is retained on a 170 mesh sieve and only 20 per cent. of the antimony sulphide, A, B, C AND D are alleged to be the more sensitive.
- (2) "A" mixture was found early in the Second World War to be too sensitive for use in certain primers, and it was replaced by the older Q.F. composition. The latter, however, is more liable to give misfires and hangfires than is "A" mixture, and Q3 composition was tried in lieu of Q.F.

Appendix D

Code indicating High Explosive Fillings with  
Composition and Percentages of Ingredients

Item No.	Filling	Composition and percentage of ingredients	Code letters and numbers stencilled on shoulder or body
1	TNT	TNT (grade 1)	TNT 1
		TNT (grade 2)	TNT 2
		TNT contaminated with up to 1% RDX	TNT 3
		9% TNT (grade 1) 7% Beeswax	TNT/BWX. 1
2	Amatol	40% Am. Nit. 60% TNT (grade 1)	AML 1
		50% Am. Nit. 50% TNT (grade 1)	AML 2
		60% Am. Nit. 40% TNT (grade 1)	AML 3
		70% Am. Nit. 30% TNT (grade 1)	AML 4
		72% Am. Nit. 28% TNT (grade 1)	AML 5
		80% Am. Nit. 20% TNT (grade 1)	AML 6
3	PE. 1	88.3% RDX 11.7% PE oil (type 1)	PE. 1
	PE. 2	88.3% RDX 11.7% PE oil (type 2)	PE. 2
	PE. 3	87.7% RDX 10.5% Shell Mex oil 119 0.6% Lecithin 1.2% Carbon black	PE. 3
	PE. 3A	87.7% RDX 6.2% Shell Mex Oil 119 4.1% Paraffin liquid Gd.1 0.5% Lecithin up to 1.5% carbon black added.	PE. 3A

Item No.	Filling	Composition and percentage of ingredients	Code letters and numbers stencilled on shoulder or body
4	RDX	91% RDX (grade 1, 1A, (B) 1, (B) 1A) 9% Beeswax	RDX/BWX. 1
		91% RDX (grade 2, (B) 2) 9% Beeswax	RDX/BWX. 2
5	RDX/PWX	86% RDX Grade 1 14% Paraffin wax	RDX/PWX. 1
6	RDX/TNT	60% RDX (grade 1, 1A, (B) 1, (B) 1A) 40% TNT (grade 1)	RDX/TNT. 1
		60% RDX (grade 2, (B) 2) 40% TNT (grade 1)	RDX/TNT. 2
		55% RDX (grade 1, 1A, (B) 1, (B) 1A) 45% TNT (grade 1)	RDX/TNT. 3
		55% RDX (grade 2, (B) 2) 45% TNT (grade 1)	RDX/TNT. 4
		50% RDX (grade 1, 1A, (B) 1, (B) 1A) 50% TNT (grade 1)	RDX/TNT. 5
		50% RDX (grade 2, (B) 2) 50% TNT (grade 1)	RDX/TNT. 6
		40% RDX (grade 1, 1A, (B) 1, (B) 1A) 60% TNT (grade 1)	RDX/TNT. 7
		40% RDX (grade 2, (B) 2) 60% TNT (grade 1)	RDX/TNT. 8
7	RDX/WAX/AL	67.5% RDX (grade 1 or 1A) 12.5% Paraffin wax 20% Aluminium	RDX/AL. 1
		68% RDX (grade 1 or 1A) 12% Paraffin wax 20% Aluminium	RDX/AL. 2

## Appendix E

### Details of Ammunition authorized for Field Branch Artillery Equipments

1. The following are the approved equipments for Field Branch Artillery:-

Q.F. 25 pr.  
B.L. 4.5 inch gun  
B.L. 5.5 inch gun  
B.L. 7.2 inch howitzer

With the exception of the 25 pr. which is Q.F. separate loading, all ammunition is of the B.L. type.

For the description and details of M.L. 4.2 inch mortar ammunition which is also equipment of Field Branch Artillery units see Chapter 11.

#### Part I. Q.F. 25-PR. Gun Ammunition

2. Ammunition of the following types is approved for this equipment, which is the standard gun/howitzer for Field Branch Artillery:-

##### PROJECTILES

Shell H.E. streamline  
Shell streamline, B.E. screening smoke  
Shell streamline, B.E. coloured smoke  
(blue, green, red, yellow)  
Shell streamline B.E. incendiary  
Shell flare, T.R., B.E. (red, green, yellow)  
Shell star  
Shell drill  
Shot A.P.  
Shot A.P.C.  
Shot practice  
Shot drill  
Shot paper  
Projectile, practice, streamline

##### CARTRIDGES

Normal  
Supercharge  
Intermediate charge increment  
Supercharge increment  
Paper shot  
Blank  
Drill



CARTRIDGES

3. Normal charges

MARK	MARK OF CART. CASE	Charge Weight			Propellant			M of P Design DD(L) 11242 Charge Type	Igniter	Primer No.	Inert Components	Remarks
		lb	oz	dr	Charge	Nature	lb					
1	2 or 2/1	1	11	4	Red White Blue	WO16 or WMO17 WO57 or WMO61 "	- 6 5 - 7 12 - 13 3	2	Nil	1	2 Cups CD No.27 Bag F 3 per set	
1	2 or 2/1	2	1	4	Red White Blue	NHO25 or NHO23	- 7 11 - 9 5 1 0 4	7	Nil	11	Cup CD No.27 Bag F 3 per set	
1 Foil	2 or 2/1	1	14	4	Red White Blue	NQ/RO14-Q4B or NQ018 NQ050 "	- 7 2 - 8 8 - 14 10	15	Nil	11	Cup CD No.27 Bag H 3 per set	
1 Foil	2 or 2/1	2	1	4	Red White Blue	NHO25 or NHO23	- 7 11 - 9 5 1 0 4	7	Nil	11	Cup CD No.27 Bag F 3 per set	
1 Foil	2 or 2/1	2	1	12	Red White Blue	NHO12 FNHO23 "	- 7 7 - 9 12 1 0 9	12	CD No.30 126 gr.	1	Cup CD No.27 Bag F 3 per set	
1/1	2 or 2/1	1	14	4	Red White Blue	NQ/RO14-Q4B or NQ018 NQ050 "	- 7 2 - 8 8 - 14 10	20	CD No. 157 16 gr. G 12	1	Cup CD No.27 Bag H 3 per set or Bag L 3 per set	Charges secured with Kraft paper
1/2	2 or 2/1	1	14	4	Red White Blue	NQ/RO14-Q4B or NQ018 NQ050 "	- 7 2 - 8 8 - 14 10	22	Nil	11	Cup CD No.27 Bag H 3 per set or Bag L 3 per set	
2	2 or 2/1	1	11	4	Red White Blue	WO16 or WMO17 WO57 or WMO61 "	- 6 5 - 7 12 - 13 3	3	Nil	1	Cup CD No.27 Bag C 3 per set or Bag F 3 per set	
2	2 or 2/1	2	1	4	Red White Blue	NHO25 or NHO23	- 7 11 - 9 5 1 0 4	8	CD No.30 126 gr.	1	Cup CD No.27 Bag F 3 per set	
2 Foil	2 or 2/1	2	1	4	Red White Blue	NHO25 or NHO23	- 7 11 - 9 5 1 - 4	8	CD No.30 126 gr.	1	Cup CD No.27 Bag F 3 per set	
2 Foil	2 or 2/1	2	1	12	Red White Blue	NHO12 FNHO23 "	- 7 7 - 9 12 1 - 9	13	Nil	11	Cup CD No.27 Bag F 3 per set	
3	2 or 2/1	1	11	4	Red White Blue	WO16 or WMO17 WO57 or WMO61 "	- 6 5 - 7 12 - 13 3	4	Nil	1	Cup CD No.27 Bag D 3 per set or Bag F 3 per set	
3 Foil	2 or 2/1	2	1	12	Red White Blue	NHO12 FNHO23 "	- 7 7 - 9 12 1 - 9	17	CD No.30 126 gr.	1	Cup CD No.27 Bag F 3 per set	
4	2 or 2/1	1	11	4	Red White Blue	WO16 or WMO17 WO57 or WMO61 "	- 6 5 - 7 12 - 13 3	3	Nil	1	Cup CD No.27 Bag F 3 per set	
4 Foil	2 or 2/1	1	11	4	Red White Blue	WO16 or WMO17 WO57 or WMO61 "	- 6 5 - 7 12 - 13 3	3	Nil	1	Cup CD No.27 Bag F 3 per set	
4 Foil	2 or 2/1	2	1	12	Red White Blue	NHO12 FNHO23 "	- 7 7 - 9 12 1 - 9	18	Nil	11	Cup CD No.27 Bag F 3 per set	
5	2 or 2/1	1	11	4	Red White Blue	WO16 or WMO17 WO57 or WMO61 "	- 6 5 - 7 12 - 13 3	4	Nil	1	Cup CD No.27 Bag F 3 per set	
5 Foil	2 or 2/1	1	11	4	Red White Blue	WO16 or WMO17 WO57 or WMO61 "	- 6 5 - 7 12 - 13 3	4	Nil	1	Cup CD No.27 Bag F 3 per set	
6 Foil	2 or 2/1	1	11	4	Red White Blue	WO16 or WMO17 WO57 or WMO61 "	- 6 5 - 7 12 - 13 3	16	Nil	11	Cup CD No.27 Bag F 3 per set	

Normal charges (continued)

MARK	MARK OF CASE	Charge Weight			Propellant			M of F Design DD(L) 112,2 Charge Type	Igniter	Primer No.	Inert Components	Remarks		
		lb	oz	dr	Charge	Nature	lb						oz	dr
7	Foil	2 or 2/1	1	11	4	Red White Blue	WO16 or WMO17 WO57 or WMO61 "			19	CD No.30 126 gr.	1	Cup CD No.27 Bag F 3 per set	N.American production. Charges secured with Kraft paper

4. Super charges

1	2 or 2/1	2	8	0	-	WI206-100 or WM/T211-100		2	8	0	5	N11	1	Cup CD No.26	All charges contain foil
1	2 or 2/1	2	9	14	-	SC/T 198-100		2	9	14	9	N11	1	Cup CD No.26	
1	2 or 2/1	2	13	8	-	NQ/S144-OLD		2	13	8	10	N11	11	Cup CD No.26	
1	2 or 2/1	2	13	8	-	NQ/S134-OLD		2	13	8	14	N11	11	Cup CD No.26	

5. Super charge increments

1	-	-	-	-		WMO61		-	4	8					In celluloid container For firing with 20 lb A.P. shot only
1	-	-	-	-		NQ/S134-OLD		-	5	8					

6. Intermediat charge increment

1	-	-	-	-		NQ/R014-048		-	4	0					In cambric bag "J" For use with charges 1 and 2 - Normal charges only.
---	---	---	---	---	--	-------------	--	---	---	---	--	--	--	--	---

7. Cartridges, blank - The marks 1 and 4 are the normal service designs used for both saluting and training purposes. The marks 2 and 3, however, are for special purposes, i.e. the Mk. 2 for saluting purposes only for Gibraltar, the Mk. 3 for saluting purposes only for Dover.

The mark 1 cartridges consists of 1 lb. gunpowder G12 in silk cloth bag in conjunction with a No. 1 primer.

The mark 2 cartridges consists of 8 oz. gunpowder G12 in silk cloth bag in conjunction with a No. 1 primer.

The mark 3 cartridges consists of 2 lb. gunpowder G12 in silk cloth bag in conjunction with a No. 1 primer.

The mark 4 cartridges consists of 1 lb. 4 oz. cordite WM.017 in bundle in conjunction with a No. 9 primer.

FUZES

8. All H.E. shell are normally issued fuzed, nose fuzed shell with either No. 117, or 213 fuzes and base fuzed shell with L15 fuzes. Exceptions are H.E. shell filled to code L7 (M. of F. designs DD(L)18851 and D2(L)554/GF/229) and those issued specifically for use with No. 213 fuzes. H.E. shell filled to code L7 are issued plugged, for use as follows:-

(a) Those fitted with Plug, F.H. 2 inch No. 13 have the top exploder assembled in position and are known as "universal cavity" shell i.e., they are suitable for use with percussion, time or V.T. fuzes viz. No. 117, 213 or T97.

(b) Those fitted with plug, F.H. 2 inch No. 29 have no top exploder present and are for use with V.T. fuzes only viz. T97.

It is important, therefore, that these two types, which are distinctly marked, be accounted for and stored separately.

All screening and coloured smoke, flare, incendiary and star shell are issued fuzed No. 221B fuzes.

PRIMERS

9. Nos. 1, 9 and 11 Primers, percussion, Q.F. cartridges are approved for use. Since the type of primer used depends on a number of factors, such as the nature of propellant, arrangement of the charge and the presence or otherwise of an igniter, repriming, when necessary owing to misfires, etc., should be carried out with primers of the same type though not necessarily of the same mark.

SHELL, Q.F. 25 pr. CHEMICAL B.E. (Fig. 55)

10. Several different marks have been introduced. The difference being as follows:-

Marks 1D - 6 D	the base of which is partially streamlined.	Weight 20 lb. 2 oz.
Mark 7D	" " " " " "	Weight 20 lb. 13 oz. (Ranges same as 1D - 6D)
Mark 8D	the base of which is streamlined (similar to the H.E. shell).	Weight 24 lb. 6 oz.
Mark 9B	" " " cylindrical and rear banded.	Weight 20 lb. 4 oz.
Mark 10B	" " " " " "	Weight 20 lb. 14 oz.

The use of these Marks of projectiles is restricted to guns in the first and second quarters of life.

SHELL, H.E. STREAMLINE

11. Empty design - The Mk.1 is the only current design. The base plate may be either screwed or plain and is finally secured by riveting.

12. Method of filling designs:-

(a) DD(L)7517 - Code L74 - This was the original design for the 25 pr. H.E. shell and provided for a main filling of TNT or amatol 40/60 with exploder, shell, CE "B" over a smoke box. Because of a temporary shortage of smoke boxes, however, the filling was varied:-

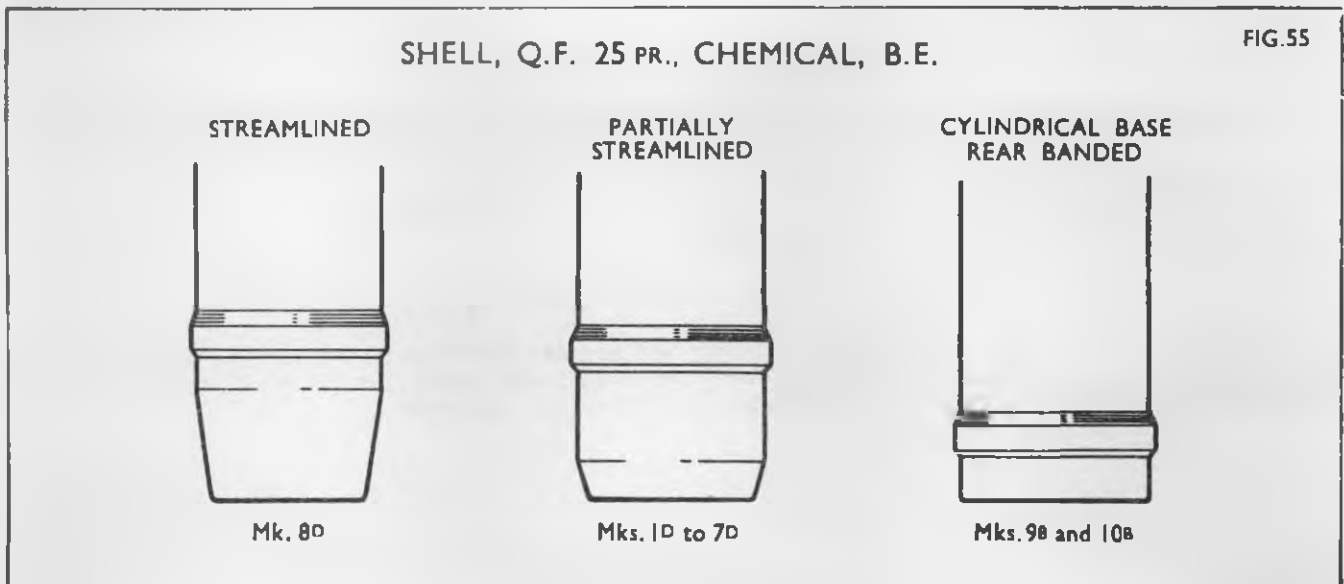
- Code L74/1 - substitution of exploder, Bag, 475 grain CE for smoke box
- L74/2 - substitution 1 oz. 5 dr. CE pellet, Mk. 1 for smoke box
- L74/3 - main filling occupies space normally taken up by smoke box

In the old system of marking under which the M.of F. design number and not the one-line-code number was stencilled on the shell the omission of the smoke box was denoted by the letter 'C' stencilled on projectiles after the design number.

(b) DD(L)18171 - Code L6 - Although this M.of F. design was also varied by the omission of smoke boxes no alteration in the code number has been made to cover the variations.

Under the old system of marking, however, the omission of smoke boxes was denoted by the letter 'A' stencilled after the M.of S. design number.

(c) DD(L)18851 - Code L7 - Shell filled to this design have a maximum depth of cavity of 5.82 inches compared with the normal 3.85 inches, and are explodered with one 14 dram C.E. pellet for use with variable time (VT) fuzes only. A requirement subsequently arose for a shell with a universal cavity explodered for use with either VT or normal DA type fuzes, and M.of F. design DD(L)18851, was therefore declared obsolescent on the introduction of D2(L)554/GF/229 - Code L7.



- (d) D2(L)554/GF/229 - Code L7 - This is the current M.of F. design and is known as the "universal cavity" type of filling in that fuzes with short magazines e.g. 117 and 119 may be used direct without alteration of the exploder system, while VT fuzes (having a greater intrusion) may be used only after removal of the 6 oz. CE top exploder.

Shell filled to this design and exploded for optional use of VT fuzes are plugged with plug, fuze-hole, 2 inch, No. 13, the top of which is painted blue to denote the presence of the top exploder and are not provided with a fixing screw hole.

37,000 shell filled to this design have been incorrectly stencilled "L36" instead of "L7". No action will be taken to amend the stencilling until the shell are due for repainting, at which time the shell markings will be rectified.

SHELL, STREAMLINE, B.E. SCREENING SMOKE

13. Empty design - Existing marks are similar in design, differing mainly in the design of driving band and in the presence or absence of a separate screwed head (nose bush), viz:-

- Mk.1 - No separate head
- Mk.2 - Fitted with separate head
- Mk.3 - Differs from Mk.2 principally in having a cone seating for the separate head.
- Mk.4 - Generally similar to the Mk. 1 but is fitted with a driving band to design DD(L)6487/7, is slightly heavier and may have a normal ogive or a separate head.
- Mk.5 - Generally similar to Mk.2 differing principally in being fitted with a driving band to design DD(L)6487/7 and in the weight.
- Mk.6 - There are two empty designs for the Mk. 6 shell, DD(L)12584 and DD(L)19349, Shell DD(L)12584 have a separate head, while those to DD(L)19349 may have a separate head or a normal ogive. Both designs are fitted with a driving band to DD(L)6487/7.

With effect from February, 1957 a new pattern base (SX 588) which is manufactured with a reduced thread area to facilitate ejection of containers will supersede marks 1 and 1/1 No. 2 bases. The No.2 bases fitted to existing stocks of empty shell will be modified to the new pattern (SX 588) prior to the empty shell being filled.

- (a) DD(L)7223B/1 Mk.1 and DD(L)9468 Mk.2 - A copper disc 0.05 inch thick is assembled between the last smoke container and the closing base, millboard discs, as required, being inserted above the copper disc to prevent movement of the smoke containers.  
The base plate for the empty Mk. 1 and 2 shell, which has a screw-threaded metal ring sweated to it, is secured to the base of the shell by means of a fixing screw. The thickness of the base plate is 0.83 inch.
- (b) DD(L)11361 Mk.3 - Base, shell, No.2, Mk. 1 or 1/1 is used. It is 0.87 inch thick and a copper disc is not, therefore, required. The base is screw-threaded but is not secured with a fixing screw.
- (c) DD(L)12582 Mk.4 - Base, shell, No. 1 Mk. 1 is used. It is generally similar to the base for the mark 1 and 2 empty shell in that it is 0.83 inch thick, has a screw-threaded metal ring sweated on, is used in conjunction with a copper disc and millboard discs, and is secured by means of a fixing screw.
- (d) DD(L)12583 Mk.5 - Base, shell, Nos. 1 or 2 may be used.
- (e) DD(L)12584 and DD(L)19349 Mk.6 - Shell to design DD(L)12584 are fitted with Base, shell, No.2 Mk.1 but shell to design DD(L)19349 are fitted with Base, shell, No.2, Mk.1/1.

14. Method of filling designs - The following method of filling designs are used:-

DD(L)7223B  
DD(L)10681 (Code L33)  
D2(L)1528/GF/135 (Code L35)

The above designs differ in minor detail only and are associated with the various marks of shell described above. All three designs provide for three containers, smoke, No.3 M.of F. design D2(L)1528/GF/135 - L33 is current and supersedes DD(L)7223B and DD(L)10681.

SHELL, STREAMLINE, B.E. COLOURED SMOKE (Blue, Green, Red and Yellow)

15. Empty designs - Coloured smoke shell are of the same empty design as screening smoke shell but when filled, a separate series of marks is allotted, viz:-

Empty Mks. 1, 2 and 3 screening smoke shell, when filled coloured smoke become Mk. 1 shell  
Empty Mks. 4, 5 and 6 screening smoke shell, when filled coloured smoke become Mk. 2 shell

Empty mark numbers are stamped and filled marks are stencilled on the shell body.

16. Method of filling designs - Both Mk. 1 and 2 shell are filled to the same designs as the screening smoke shell except that the smoke containers are charged with coloured smoke compositions. M.of F. design D2(L)1528/GF/135 supersedes DD(L)10681 and DD(L)17625. As the differences are in minor detail only, however, all three M.of F. designs have been allotted code L33/4.

17. Container, smoke - There are two variations of steel container, smoke, No.3 mark 2, viz., container, smoke, B.E. (for use with streamline B.E. screening smoke shell) the central tube of which is not fitted with steel plugs, and container, coloured smoke (for use with coloured smoke shell) the central tube of which is fitted with a drilled steel plug at each end.

SHELL, FLARE, T.R. B.E. (Target Recognition, Base Ejection)

18. Empty design - The empty shell is of the same design as the streamline B.E. Mk.6 screening smoke shell, although the word "streamline" has been omitted from the nomenclature.

19. Method of filling design - Shell to this design (D2(L)449/GF/193 - Code L45/3) are fitted with three containers filled SR flare composition which may be one of three colours i.e. red, green or yellow. Containers of different colour composition are not mixed in the same shell.

SHELL, STREAMLINE, B.E. INCENDIARY

20. Empty design - The empty shell is the same design as the streamline B.E. Mk.6 screening smoke shell.

21. Method of filling design - The shell are filled to design DD(L)11182. Either of two types of steel container may be used, viz., container No.1 or container No.10. Those shell filled with container No. 1 are allotted code L33/8 and those filled with container No. 10 - L33/9.

STAR SHELL

22. Empty design - The empty shell is manufactured to design DD(L)17894/1. It is not streamlined although the portion below the driving band is slightly tapered. This is a base ejection shell although the abbreviation "B.E." has been omitted from the nomenclature.

23. Method of filling design - The shell is filled to design DD(L)17894 (Code L35). This M.of F. design is typical for all star shell. The parachute has a diameter of 18 inches and the colour of the star is white.

SHOT A.P.C.

24. The mark 7 design is similar to the shot A.P. Mk.6, but is fitted with a penetrative cap which is monolized to the shot.

SHOT PRACTICE

25. The mark 1 practice shot is an exception to the general policy being made of mild steel instead of cast iron. Marks 1 and 2 shot are fitted with internal tracer No. 2 mark 7, all other shot being recessed to receive an integral tracer filling which may produce a red or white trace according to the method of filling design.

## Appendix E

### Part 2. B.L. 4.5-inch Gun Ammunition

26. Ammunition of the following types is approved for this equipment, which is the standard medium gun for Field Branch Artillery:-

PROJECTILES

Shell, H.E. streamline  
Shell drill

CARTRIDGES

First charge  
Third charge (comprises charge 2 and 3)  
Blank  
Drill

CARTRIDGES

27. There are two main types of cartridges, these being:-

- Charge 1
- Charge 3

28. Charge one:-

- (a) 2 lb. 15 oz. cordite SC.048, Mk.1, 2 lb. 15 oz. cordite W.057, Mk.1, 2 lb.15 oz.cordite WM.051 Mk.1 - These cartridges differ only in the type of propellant used. The cartridge is of the stalk type and is fitted with a 1 oz. "A" igniter at the larger end.
- (b) 2 lb. 15 oz. cordite WM.061, Mk.2 (illustrated in Fig. 7 ) - This differs from the Mk.1 cartridge in being cylindrical in shape and in being fitted with a 1 oz. G12 gunpowder igniter.
- (c) 3 lb. 1 oz. cordite NQ.050 Mk.1 - This cartridge is of the stalk type. It is fitted with two igniters; a 1 oz. "A" being fitted to the rear of the larger diameter section, the other of 1.1/2 oz. G.12 gunpowder is ring shaped and is fitted to the front end of this section.
- (d) 3 lb. 1 oz. cordite NQ.050 Mk.2 - This differs from the Mk.1 cartridge in being cylindrical in shape.

29. Charge three:-

- (a) 9 lb. 2 oz. cordite SC.109 Mk.1 foil, 9 lb. 2 oz. cordite W.124 Mk.1 foil, 9 lb. 2 oz. cordite WH.124, Mk.1 foil, 9 lb. 2 oz. cordite WM.130 Mk.1 foil - The cartridges differ only in the type of propellant used. They consist of a 6 lb. 7 oz. charge two portions fitted with a 1 oz. "B" igniter, and a 2 lb. 11 oz. charge three increment. Both portions are cylindrical in shape and lead or tin foil is incorporated at the inner end of each portion.
- (b) 10 lb. 9 oz. cordite N/S 164-048, Mk. 1 foil (illustrated in Fig. 7 ) - This consists of a 7 lb. 9 oz. charge two portion and a 3 lb. charge three increment. Both portions are cylindrical in shape. The charge two portion is fitted with two igniters, one a 1 oz. G12 gunpowder and the other a 2 oz. "A". Lead or tin foil is incorporated in the outer end of the charge three increment, and also wrapped around the propellant of the charge two portion.

FUZES

30. H.E. shell are issued plugged being fitted with plug, F.H. 2 inch No. 13. The top exploder is assembled in position, and the shell are suitable for use with either No.117, or 213 fuzes.

IGNITERS, AUXILIARY

31. Cartridges, B.L. igniters auxiliary "C" are issued for use with cartridges in the event of the existing fitted igniters becoming damp. They consist of two red worsted cloth discs sewn together by two rings of stitching, and sewn across to form five parallel compartments which are fitted with 1 oz. gunpowder G12. A drawstring of silk or worsted webbing is threaded around the edge of the igniter to form a skirt and to secure the igniter to the cartridges.

SHELL H.E. STREAMLINE

32. Empty design - Only one mark of H.E. shell was produced for this equipment. The shell is manufactured to design DD(L)8102 and is fitted with a driving band to design DD(L)6817/2. The design covers two alternative heads, one being in the form of a mild steel bush. The base plate may be either screwed or plain and is finally secured by riveting.

33. Method of filling designs - The following method of filling designs are used:-

- |                              |                                |
|------------------------------|--------------------------------|
| DD(L)7342                    | DD(L)17865 (Code L1/1 or L1/3) |
| DD(L)7343C                   | DD(L)19506 (Code L3)           |
| DD(L)11561                   | DD(L)869/GF/235 (Code L6)      |
| DD(L)16879 (Code L1 or L1/2) | D2(L)903/GF/317 (Code L1/2)    |

In 1944 it was decided to modify all B.L. 4.5 inch H.E. shell fitted with plug, fuze-hole, 2 inch No.13. This modification consisted of fitting a top exploder together with a plug, fuze-hole, 2 inch No.13 or a converted plug, fuze-hole, 2 inch No.3. The conversion of the latter plug consisted of cutting off the shank, smoothing the face of the boss and chamfering its edge. This converted plug is slightly deeper than the plug No.13 but this difference was considered to be acceptable. The top of both types of plug was painted blue. No attempt was made to alter the M.of F. design number stencilled on the shell as the blue plug indicates the presence of a top exploder.

34. Surroundings and toppings - TNT surrounds and toppings are used with shell filled amatol. TNT toppings are used with RDX/TNT fillings.

35. Exploder containers - All amatol filled shell employ a steel exploder container. Shell filled to design DD(L)19506 are fitted with a container, steel, No.4, all other amatol filled shell being fitted with a container, steel, No.1. A container, steel, No.1 is also used with shell filled TNT to DD(L)17865.

36. Smoke boxes - Shell fitted with red phosphorus smoke boxes have been found to be liable to phosphoric acid exudation due to moisture entering badly sealed boxes. All red phosphorus smoke boxes are, therefore, being replaced by TNT/AL smoke pellets, as smoke production is still an observation requirement for Field Branch Artillery.

TUBES

37. Tubes, percussion, S.A. cartridge are approved for use with this equipment.

Appendix E

Part 3. B.L. 5.5-inch Gun Ammunition

38. Ammunition of the following types is approved for this equipment, which is the standard medium gun/howitzer for Field Branch Artillery:-

PROJECTILES

- Shell, H.E. streamline (100 lb.)
- Shell, H.E. streamline, 80 lb.
- Shell, chemical B.E. streamline
- Shell, incendiary B.E.
- Shell, B.E. screening smoke
- Shell B.E. coloured smoke (blue, green, red, yellow)
- Shell flare, T.R., B.E., (red, green)
- Shell drill
- Shot paper

CARTRIDGES

- Charge two (comprises charge 1 and 2)
- Charge four (comprises charge 3 and 4)
- Super-charge (for use with 80 lb. shell only) (previously designated "full charge")
- Charge for paper shot
- Blank
- Drill

CARTRIDGES

39. There are four main types of cartridges, these being:-

- Charge 2
- Charge 4
- Super-charge (for use with 80 lb. shell only)
- Paper shot cartridges

40. Charge two:-

- (a) 4 lb. 4 oz. cordite W.057, Mk.1, 4 lb. 4 oz. cordite WM.061, Mk.1 - The cartridges differ only in the type of propellant used. They consist of a 2 lb. 10 oz. 8 dr. charge one portion fitted with a 2 oz. "C" igniter and a 1 lb. 9 oz. 8 dr. charge two increment. The charge one portion is of the stalk type while the increment is a flat bag which is wrapped around and secured to the stalk.
- (b) 4 lb. 4 oz. cordite WM.061, Mk.3 - This is in two portions, which although of the same weight as the Mk.1 cartridge, are cylindrical in shape. The charge one portion is fitted with a 2 oz. G12 gunpowder igniter at one end. The outer end of the charge two increment is fitted with a lifting becket.
- (c) 4 lb. 12 oz. cordite NQ.050, Mk.1 - This is in two portions, cylindrical in shape, charge one being of 2 lb. 15 oz. and charge two increment of 1 lb. 13 oz. The charge one portion is fitted with two igniters i.e., a 1 oz. "D" and a 1 oz. G12 gunpowder igniter.
- (d) 5 lb. NH.025, Mk.1 - This consists of a 3 lb. 1 oz. stalk type charge one and a 1 lb. 15 oz. charge two increment in the shape of a flat bag which is curved and secured by ties around the stalk of the other portion. The charge one portion is fitted with a 1 oz. "C" or G12 gunpowder igniter.
- (e) 5 lb. FNH.023 Mk.1 - This consists of a 3 lb. 5 oz. stalk type charge one portion and a 2 lb. charge two flat increment. The charge one portion is fitted with a 1 oz. G12 gunpowder igniter.

- (f) 5 lb. 5 oz. FNH.023, Mk.2 (illustrated in Fig. 8) - This consists of a 3 lb. 3 oz. charge one portion and a 2 lb. 2 oz. charge two increment. The charge one portion is fitted with a 1 oz. G12 gunpowder igniter.

41. Charge four:-

- (a) 9 lb. 2 oz. cordite W.104, Mk.1, 9 lb. 2 oz. cordite WM.109, Mk.1 foil - These cartridges consist of a 6 lb. 10 oz. 8 dr. charge three portion and a 2 lb. 7 oz. 8 dr. charge four increment. These are both cylindrical in shape. The charge three portion is fitted with a 1 oz. "C" igniter. Lead or tin foil discs are positioned in the inner end of the charge four increment.
- (b) 9 lb. 13 oz. cordite NQ/S 164-048 Mk.1 foil (illustrated in Fig. 8) - This consists of a 7 lb. 3 oz. charge three portion and a 2 lb. 10 oz. charge four increment. The charge three portion is fitted with two igniters, a 2 oz. G12 gunpowder at one end and a 1 oz. "C" at the other end. Lead or tin foil is positioned in the outer end of the increment. Both portions are cylindrical in shape.
- (c) 10 lb. 14 oz. FNHP.038, Mk.1 - This consists of an 8 lb. charge three portion and a 2 lb. 14 oz. charge four increment. Both are cylindrical in shape. Charge three portion has a 2 oz. G12 gunpowder igniter fitted at each end while lead or tin foil is incorporated in the charge four increment.
- (d) 10 lb. 14 oz. 8 dr. NH.047, Mk.1 foil - This consists of a 7 lb. 13 oz. charge three portion and a 3 lb. 1 oz. 8 dr. charge four increment. Both are cylindrical in shape. An igniter is attached to each end of the charge three portion, and lead or tin foil discs are placed in the front end.

42. Super charge (previously designated full charge) (for 80 lb. shell):-

- (a) 11 lb. 8 oz. cordite WM.130, Mk. 1 foil - This is in one portion which is fitted with a 1 oz. "C" or "F" igniter, lead or tin foil being positioned in the opposite end. There are two alternative methods of making up this charge.
- (b) 11 lb. 8 oz. cordite WM. 130, Mk. 2 foil - This is in one portion which is fitted with a 1 oz. "H" igniter. It is of Canadian production and differs from the Mk.1 only in the cartridge bag and igniter used.
- (c) 12 lb. 9 oz. NS.164-048, Mk.1 foil (illustrated in Fig. 8) - This is in one portion and is fitted with two igniters i.e. a 2 oz. G12 gunpowder and a 2 oz. "B". Lead or tin foil is wrapped around the charge. There are two alternative methods of making up this charge.

43. Paper shot

9 lb. 4 oz. cordite WM.109, Mk.1 - This is in one portion which is fitted with a single 1 oz. "C" igniter, and is approved for use with the 160 lb. paper shot.

FUZES

44. All shell are issued plugged.

H.E. shell may be fitted with plug, F.H. 2 inch No. 13, in which case the top exploder is assembled in position and are suitable for use with either No.117 or 213 fuzes or with plug, F.H. 2 inch No. 29 in which case no top exploder is present and they are suitable for use with T100 fuze. (H.E. 80 lb. shell only).

All screening and coloured smoke, and incendiary shell are suitable for use with No.221B fuzes. Flare shell are suitable for use with No.221B fuzes.

IGNITERS AUXILIARY

45. Cartridge, B.L., igniters auxiliary "C" are issued for use with the cartridges in the event of the existing igniters becoming damp. They consist of two red worsted cloth discs sewn together by two rings of stitching, and sewn across to form five parallel compartments which are filled with 1 oz. of gunpowder G12. A drawstring of silk or worsted webbing is threaded around the edge of the igniter to form a skirt and to secure the igniter to the cartridge.

SHELL, H.E.

46. In general the difference of weight between the 100 lb. and 80 lb., H.E. shell is achieved by enlarging the cavity of the latter, thus reducing the amount of metal used. It is also slightly shorter. It is important to note that the explosive content of the 80 lb.shell is considerably higher than that of the 100 lb. shell.



SHELL, H.E. STREAMLINE

47. Empty design:-

- (a) Mk.1 (100 lb.) - This shell is manufactured to design DD(L)9471 and is fitted with a driving band to design DD(L)9506/1. The empty design covers two alternative heads, one being in the form of a mild steel bush. Shell may be found in which the body is relieved in diameter between a 1.5 inch band at the shoulder and a 1.0 inch band formed immediately in front of the driving band. The base plate may be 2.8 inch or 3.0 inch diameter either of which may be screwed or plain. All base plates are finally secured by riveting.
- (b) Mk.2 (100 lb.) - This shell is manufactured to design DD(L)11368. It differs from the mark 1 shell in being made of cast iron and in being fitted with a driving band to design DD(L)11367/7. There is no alternative head and the shape of the cavity differs from the mark 1 design. The base plate is 2.8 inch diameter and may be screwed or plain, and finally secured by riveting.
- (c) Mk.3 (100 lb.) - This shell is manufactured to design DD(L)16033 and is similar to the mark 1 shell, differing only in having a driving band to design DD(L)11367/6. Only 2.8 inch diameter base plates are fitted.
- (d) Mk.4 (80 lb.) - This shell is manufactured to design DD(L)11236B and is fitted with a driving band to design DD(L)11367/5. The reduction in overall weight is achieved by enlarging the cavity, thus reducing the amount of metal used. The differences from the 100 lb. Mk.1 shell are that the 80 lb. shell is slightly shorter and does not use a 3 inch diameter base plate.
- (e) Mk.2 (80 lb.) - This shell is manufactured to design DD(L)17809 and is fitted with a driving band to design DD(L)16872/1. It is similar to the mark 1 80 lb. shell in other details.
- (f) Mk.3 (80 lb.) - This shell is manufactured to the same design as the mark 2 80 lb. shell and differs only in the form of steel used.
- (g) Mk. 3 converted (80 lb.) - This shell is a mark 3 80 lb. converted under design DD(L)18653. The conversion consists of increasing the diameter of the lower end of the fuze-hole to permit the use of V.T. fuzes.
- (h) Mk.4 (80 lb.) - This shell is manufactured to design D2(L)666/GE/263, and is the new production of the mark 3 converted shell.

48. Method of filling designs - The following method of filling designs are used:-

DD(L)10226	DD(L)18851 (Code L7)
DD(L)10226A	DD(L)19506 (Code L3)
DD(L)10911	D2(L)501/GE/210 (Code L7)
DD(L)16879 (Code L1 or L1/2)	D2(L)869/GE/235 (Code L6)
DD(L)17865 (Code L1/1 or L1/3)	

In 1944 it was decided to modify all B.L. 5.5 inch H.E. shell fitted with plug, fuze-hole, 2 inch No.3 as described in para. 33.

49. Surrounds and toppings - TNT surroundings or toppings are used with shell filled amatol, water-proof composition or TNT toppings are used in shell filled RDX/TNT.

50. Exploder containers - All amatol filled shell employ a steel exploder container. Shell filled to design DD(L)19506 are fitted with a container, steel No. 4 or No. 27 and all other amatol filled shell use a container, steel No. 1. A container, steel, No. 1 is also used with shell filled TNT to design DD(L)17865.

51. Smoke boxes - Shell fitted with red phosphorus smoke boxes have been found to be liable to phosphoric acid exudation due to moisture entering badly sealed boxes. All red phosphorus smoke boxes are, therefore, being replaced by TNT/AL smoke pellets, as smoke production is still an observation requirement for Field Branch Artillery.

SHELL, FLARE, T.R. B.E. (Target Recognition, Base Ejection)

52. Empty design - The empty shell is manufactured to design D2(L)574/GE/91 and is in four parts, viz., body nose bush No.10, disc, fuze-hole, No.2 and base, No.12

53. Method of filling design - Mk.1 shell to this design (DD(L)20151 - Code L46) are fitted with four containers filled SR flare composition which may be one of two colours i.e., red or green.

SHELL B.E. INCENDIARY

54. Empty design:-

- (a) The Mk.1 shell is manufactured to the same empty design as the Mk. 1 smoke shell.
- (b) The Mk.2 shell is manufactured to empty design DD(L)19586 and differs from the mark 1 in being fitted with a base, shell, No.15.

55. Method of filling designs:-

- (a) The mark 1 shell is filled to design DD(L)14424 (Code L34/1), being fitted with six steel containers, incendiary, No.2, Mk.1.
- (b) The mark 2 shell may be filled to design DD(L)18778 (Code L34/2) or DD(L)18953 (Code L34/3). The former caters for four steel containers, incendiary No.3, Mk.1, the latter for six steel containers, incendiary, No. 4, Mk.1.

SHELL, B.E. SMOKE

56. Empty designs - All smoke shell, screening and coloured, are manufactured to the same empty design.

Mk. 1 DD(L)13726/1  
Mk. 2 D2(L)844/GF/79

The empty design consists of four parts, these being:- body, nose bush, disc, fuze-hole, No.2 and base No.13.

The Mk.1 shell is fitted with a No.3 bush and the Mk.2 shell is fitted with a No.10 nose bush, this is the only difference between these empty designs.

57. Method of filling designs

The Mk.1 B.E. screening smoke shell is filled to design DD(L)13726.

The Mk.1 coloured smoke shell is filled to design DD(L)19103, the smoke compositions used varying according to the colour of the smoke it is desired to produce.

All Mk.2 smoke shell are filled to design D2(L)744/GF/92 (Code L34/4) or D2(L)1562/GF/480 (Code L34/5 for screening smoke and L34/7 for others).

The mark 1 screening smoke shell are fitted with 6 steel containers No. 6 mark 1 whilst mark 2 are fitted with 4 steel containers No. 17 mark 1. The central tube of containers used in screening smoke shell are not fitted with steel plugs.

The mark 1 coloured smoke shell are fitted with 6 steel containers No.6 mark 1 whilst mark 2 are fitted with 4 steel containers No. 17 mark 1. In the case of the mark 1 green, red and yellow smoke shell the central tube of the container is fitted with a drilled steel plug at each end. Similarly, steel plugs are also fitted at each end of the central tube of the containers assembled in the mark 2 red smoke shell.

TUBES

58. Tubes, percussion, S.A. cartridge are approved for use with this equipment.

## Appendix E

### Part 4. B.L. 7.2-inch Gun Ammunition

59. Ammunition of the following types is approved for the equipment, which is the standard British heavy howitzer for Field Branch Artillery:-

PROJECTILES

Shell H.E. streamline (Mk. 1 is non-standard)  
Shell drill  
Shot, paper

CARTRIDGES

Third charge  
(comprises charges 1, 2 and 3)  
Fourth charge  
Charge 5 increment (charge 5 is obtained by adding the increment to charge 4)  
Blank  
Drill

CARTRIDGES

60. There are three main types of cartridges, these being:-

Charge 3  
Charge 4  
Charge 5 increment

61. Charge three:-

- (a) 11 lb. 10 oz. cordite WM.061 Mk. 1 - This consists of a 5 lb. 8 oz. stalk type charge one portion, a charge two increment of 1 lb. 11 oz. and a charge three increment of 4 lb. 7 oz. in the form of flat bags.  
The charge one portion is fitted with a 6 oz. "A" igniter.
- (b) 13 lb. 11 oz. cordite N.045, Mk.1 (illustrated in Fig. 9) - This consists of three cylindrical shaped portions laced together. The charge one portion of 6 lb. 10 oz. 8 drs. is fitted with a 6 oz. "A" igniter. The charge two increment is of 2 lb. 2 oz. while the charge three increment is 4 lb. 14 oz. 8 dr.  
With effect from 3rd November, 1945 a lifting becket is fitted to the charge three portion.
- (c) 14 lb. 13 oz. 8 dr. FNH.025 and NH.050 Mk. 1 - This consists of a stalk type charge one portion of 6 lb. 11 oz. FNH.025 and two ring shaped increments; the charge two increment of 2 lb. 3 oz. 8 dr. FNH.025 and the charge three increment of 5 lb. 15 oz. NH.050. A 6 oz. G12 gunpowder igniter is fitted to the charge one portion.
- (d) 16 lb. 3 oz. 8 dr. FNH.025 and .057, Mk.1 - This consists of a stalk type charge one portion of 6 lb. 11 oz. of FNH.025 and two ring shaped increments; the charge two increment of 2 lb. 3 oz. 8 dr. FNH.025 and the charge three increment of 7 lb. 5 oz. NH.057. A 6 oz. G12 gunpowder igniter is fitted to the charge one portion.
- (e) 16 lb. 3 oz. 8 dr. FNH.025 and .057 Mk. 2 - This differs from the Mk.1 only in being made up in three cylindrical shaped portions laced together.

62. Charge four:-

- (a) 24 lb. cordite N/S 198-054, Mk. 1 foil (illustrated in Fig. 9) - The cordite is bundled and secured with .35 inch wide worsted webbing. Wrapped around this bundle is a sheet of lead or tin foil secured with sewing silk. The made up charge is filled into a silk cloth bag fitted at one end with a 6 oz. "B" igniter and at the other end with a 6 oz. G12 gunpowder igniter. Cartridges filled after 5th June, 1945 are fitted with a lifting becket at the G12 gunpowder igniter end.
- (b) 25 lb. FNH.057, Mk. 1 - This consists of 25 lb. of loose propellant filled into a silk cloth bag with a sheet of lead or tin foil loosely crumpled and placed on top of the propellant filling. The bag is choked and secured with sewing silk, a 6 oz. G12 gunpowder igniter being attached to the opposite end.

63. Charge five increment:-

Cordite N/S 198-054, charge 5 increment charge, 7 lb. Mk. 1 (illustrated in Fig.9) - This consists of cordite, bundled, using .35 inch wide worsted webbing. The made up charge is contained in a silk cloth bag at one end of which is fitted a 1 oz. "J" igniter, a 1 oz. G12 gunpowder igniter being fitted at the other end.

With effect from 6th June, 1945, a lifting becket is fitted at the G12 gunpowder igniter end. It is restricted to use in mark 6 Howitzers only.

FUZES

64. H.E. shell are issued plugged being fitted with plug F.H. 2 inch No. 13. The top exploder is assembled in position, and the shell are suitable for use with either No.117 or 213 fuzes.

SHELL H.E. STREAMLINE

65. Empty design:-

- (a) Mk. 1D - This shell is manufactured to design DD(L)11437 and follows the conventional design for H.E. shell. There are four, alternative base plates i.e., 0.49 inch thick-one plain, the other screwed and 0.34 inch thick-one plain, the other screwed. All are 4.5 inch in diameter. The head of the shell may be either plain or in the form of a bush. The walls may be relieved in diameter between a 2 inch band formed at the shoulder and a 1 inch band immediately in front of the driving band. The shell is fitted with a single driving band to design DD(L)11454/1.

(b) Mk. 2D - This shell is manufactured to design DD(L)13332 and differs from the mark 1D shell in being fitted with a double driving band to design DD(L)12496/1.

66. Method of filling designs - The following method of filling designs are used:-

DD(L)11935  
DD(L)13005

DD(L)13005A  
DD(L)16362

DD(L)16817  
DD(L)19507

All these method of filling designs cover the use of amatol 50/50 but designs DD(L)11935, DD(L)13005, DD(L)13005A and DD(L)16362 permit the use of alternative proportions of this filling. Method of filling designs DD(L)13005A and DD(L)16362 have an unusual exploder arrangement in that each incorporates three bag exploders, one of which is positioned below the steel exploder container.

DD(L)13005 A incorporates a C.E. 'A' exploder below the exploder container owing to a temporary shortage of smoke boxes. To meet observation requirements this design calls for a 6 oz. smoke box to be incorporated in the H.E. filling. A quantity of shell filled at R.O.F. Elstow do not include this smoke box and they thus bear a marking to indicate its absence.

The third exploder used in design DD(L)16362 is a C.E. "Z" exploder.

67. Surrounds and toppings - DD(L)19507 incorporates a TNT topping while all other designs make use of TNT surrounds.

68. Exploder containers - A No. 3 exploder container is used in shell filled to design DD(L)19507, all other shell being fitted with a No. 1 exploder container.

69. Smoke boxes - Shell filled to design DD(L)13005 were originally assembled with a 1.1/4 oz. or 1.1/2 oz. red phosphorus smoke box. Owing to the danger of phosphoric acid exudation from badly sealed smoke boxes these have been replaced with a 1 oz. 8 dr. TNT/AL smoke pellet.

#### TUBES

70. Tubes, percussion, S.A. cartridge are approved for use with this equipment.

## Appendix F Particulars of Fuzes

### FUZE. PERCUSSION. D.A. NO. 117

1. Type Perc., direct action
2. Guns Q.F. 3.7 inch Mks. 1 to 3 guns  
Q.F. 5.25 inch gun  
Q.F. 25 pr. gun  
Q.F. 3.7 inch howr.  
B.L. 4.5 inch gun  
B.L. 5.5 inch gun  
B.L. 7.2 inch howr.
3. Projectile H.E. shell, smoke and chemical bursting shell.
4. Description - Mark 18 (Fig. 56)
5. General - This is a detonating fuze of the 2 inch fuze-hole gauge, and is used with streamline shell when instantaneous effect is desired.  
It consists principally of a body, magazine with bottom cap, shutter and detonator, locking weight, guide bush, percussion and arming arrangements, striker cover and safety cap.
6. Body - This is of brass, the lower portion being screw-threaded externally to the 2 inch fuze-hole gauge and the upper portion, conical in shape, bored and screw-threaded internally to receive the guide bush, below which a plain portion receives the percussion and arming arrangement. Two holes are bored through the body diaphragm to connect the lower recess to the upper recess and act as vent holes to relieve pressure in the lower recess should a detonator fire on shock of discharge. One of these holes is situated immediately over the detonator when the shutter is in the unarmed position. Two key holes are drilled in the side to take a key for inserting or removing the fuze.  
The base is recessed to house the shutter and locking weight and screw-threaded to receive the magazine. The upper and lower cavities are connected by a central boring to receive the point of the striker. The lower end of the upper cavity boring is coned to house the lower end of the arming spring to obviate the possibility of the spring being trapped under the flange of the striker spindle.  
Holes are drilled in the underside of the body recess to receive a hinge pin for the shutter and one for the locking weight, in addition to one for a brass stop pin with a fibre sleeve, or a fibre stop pin. To prevent the magazine from fouling the shutter by being screwed too far in, two distance pins are positioned in the shutter recess.
7. Magazine - This is of brass and is screw-threaded externally to suit the body. It is reduced in diameter at the bottom and screw-threaded to receive a bottom cap, which is crimped in two or more places equi-distantly spaced after filling. This crimping combined with the securing pin is to lock the threads against unscrewing. The cap retains the C.E. pellet in the magazine.  
It is bored from the base in two diameters, the larger bore containing a C.E. pellet which is assembled with the hard end next to the bottom cap, a paper disc being shellacked to the top surface. The smaller bore is within a fraction of an inch of the top surface of the magazine leaving a thin metal diaphragm, and is filled with loose C.E. stemmed in.
8. Shutter - This is of brass and is located between the upper face of the magazine and the underside of the body diaphragm.  
It is bored through the centre for its hinge pin and prepared with a recess at one end to receive the detonator.  
A recess is formed in the side of the shutter, its face being machined to form a working surface for the toe of the locking weight. The end opposite the detonator recess is enlarged to form a weight to operate under centrifugal force.
9. Detonator - This is a 5.7 grain "AZ" tinned lugless detonator.



10. Locking weight - This is of brass and is an arc-shaped fitment located above the magazine and is forked at one end to receive the shutter spring and bored vertically for its hinge pin. The other end is formed with a toe which is machined to act as a working surface in the recess in the side of the shutter under the influence of the shutter spring, thus masking the central hole in the body diaphragm.

The upper surface of the toe is recessed to accommodate the point of the striker to prevent the shutter opening whilst the fuze is at rest and until acceleration has ceased in the gun.

11. Guide bush - This is of metal and formed with a flange about its centre which is coned to suit the contour of the body and milled around its edge. It is screw-threaded externally above and below the flange, the upper to receive the safety cap and the lower to suit the top of the fuze body.

It is bored through the centre to form a guide for the striker, the upper end of the boring being enlarged to form a seating for the striker cover and spring. The lower end of the boring is formed with a countersunk edge to bear against the segments.

A recess on the under surface forms a seating for the arming sleeve. A securing pin locks the threads against unscrewing.

12. Percussion and arming arrangements - These consist of a striker with a head, striker spring, striker sleeve, segments, arming sleeve and spring.

- (a) Striker - This is of steel and is in two parts e.g. striker and head, which are secured together by a split pin.  
The striker is a metal rod circular in section having a point at its lower end, above which is formed a flange against which bears the lower end of the striker sleeve. The upper end is reduced in diameter to fit the head and bored to receive a split pin.  
The striker head is a mushroom-shaped fitment which is bored to fit the striker spindle, a radial boring accommodating the split pin. When assembled with its sleeve and segments the flange has a small clearance between its lower edge and the seating for the arming spring in the body diaphragm.
- (b) Striker spring - This is of steel, circular in section, and is assembled under initial compression between the striker head and the upper face of the guide bush. When the striker is released by the falling away of the segments, the spring reasserts itself, and so doing withdraws the point of the striker out of the recess in the locking weight.
- (c) Striker sleeve - This is of brass, cylindrical in shape and fits over the striker spindle, bearing against the upper face of the flange on the striker. Its upper end is chamfered to bear against the lower countersunk edges of the segments.
- (d) Segments - These, four in number, form a hollow cylinder around the spindle and are assembled between the lower end of the guide bush and the upper end of the striker sleeve, and maintain the striker spring under its initial compression, until released by acceleration and centrifugal force.  
The upper edge of the segments is chamfered, while the lower edge is countersunk, viewing the segments as a cylinder.
- (e) Arming sleeve - This is a hollow cylindrical brass fitment, the upper and lower edges being turned over to form bearing surfaces for the arming spring and under surface of the guide bush. The arming sleeve retains the segments in position until released by acceleration. The sleeve is kept up to its work by an arming spring which is assembled on the outside of the striker sleeve, one end bearing against the arming sleeve and the other in the recess in the upper face of the body diaphragm.

13. Striker cover - This is of brass, dome-shaped and positioned over the striker head, being seated in the upper recess in the guide bush. This cover prevents pressure of the air, during flight, acting on the striker head, so causing premature action of the striker.

This cover must not be removed when preparing the fuze prior to loading.

14. Safety cap - This is of steel or malleable cast iron, dome shaped and has a flat steel spring riveted into an oblique slot on one side. The free end of the spring engages in the milling on the guide bush and retains the cap in position. The cap is formed with a milled ring around its circumference and is screw-threaded internally at its lower end for attachment to the guide bush.

As an alternative the cap may be manufactured of zinc-alloy but is similar in shape to the steel cap.

The cap is painted or lacquered black externally.

15. Safety Arrangements - The following safety arrangements are incorporated:-

- (a) The safety cap which protects the striker cover and striker.
- (b) The segments held in place by the arming sleeve and arming spring which acting through the striker sleeve hold the striker in position in the locking weight.
- (c) The shutter held by the locking weight in such a position that the detonator is not aligned below the point of the striker.

16. Action - When preparing this fuze for firing the black steel safety cap only is to be unscrewed and removed.

17. On firing - The acceleration of the shell in the bore causes the arming sleeve to set back and compress the arming spring between itself and the bottom of the recess in the upper surface of the body diaphragm. This movement uncovers the segments and, combined with a slight set back of the striker, releases the four segments and permits them to fall clear. Should acceleration not displace the segments they will be positively displaced by centrifugal force.

18. During flight - As deceleration sets in, the striker spring, which is assembled under compression, reasserts itself against the underside of the striker head, forcing the striker and striker sleeve forward until the upper end of the sleeve meets the under surface of the guide bush, withdrawing the point of the striker out of the recess in the locking weight. This allows the locking weight to revolve around its hinge pin under the action of centrifugal force. In doing so its toe starts the shutter turning on its hinge pin. This action is arranged to ensure that the shutter shall revolve into its armed position. The shutter is so shaped that centrifugal force can only cause it to revolve around its hinge pin gently and the locking weight gives it a start. Centrifugal force then continues to revolve the shutter gently until it reaches the stop pin which locates the detonator under the striker point. In this way shock to the detonator, when the shutter moves to the armed position, is avoided. The stop pin is fitted with a fibre sleeve for the same purpose.

The fuze is now fully armed, the striker point being held clear of the detonator by the striker spring and the retardation of the shell due to air resistance acting on the mass of the striker.

19. On impact - The striker cover is forced on to the striker head, the striker being forced inwards compressing the striker spring, causing the point of the striker to pierce the detonator. The resulting detonating wave passes through the magazine diaphragm to the small column of stemmed C.E. which in turn fires the C.E. pellet in the magazine and the bursting charge in the shell.

20. Difference in marks - The following shows briefly the various differences in patterns:-

Mark 1 (cancelled)

This mark was allocated to a design of No. 117 fuze which was never produced for Service use and has since been cancelled.

Mark 2 (obsolete)

This fuze consists of a body, magazine with bottom cap, shutter with detonator, locking weight, guide bush, percussion and arming arrangement and safety cap.

These fuzes have been modified to approximate to the mark 3 by forming an annular recess to receive the lower end of the arming spring. No advance of numeral being made.

Mark 3 (obsolescent)

Similar to the mark 2 but has shape of shutter amended and may be of mazak with a brass insert. Body may be of zinc base alloy, has small alterations to dimensions and omission of upstand round forward end of striker hole.

Mark 3A (obsolescent)

Similar to mark 3 differing principally in the shutter recess being fitted with an extra distance pin.

Mark 4 (obsolete)

Differs from the mark 3 in being made with a steel magazine, guide bush and body.

Mark 5 (obsolete)

Differs from mark 4 principally in being fitted with weaker arming and shutter springs.

Mark 6 (Obsolete)

Similar to mark 4 but has a cast iron body and mazak ring screwed under the flange, making a shorter magazine recess. The shorter magazine takes a shorter and narrower pellet. Has a longer striker below the flange, also a shorter magazine set screw.



Mark 7 (cancelled)

Similar to the mark 3A but differs in being fitted with a modified shutter to accommodate a 6 grain detonator filled D.C.A./lead azide/C.E. (AZY). The striker and striker head was of aluminium alloy and the thickness of the magazine diaphragm was .01 - .03 instead of .003 - .008.

Mark 8 (obsolescent)

Similar to the mark 3A but incorporates a two piece light alloy striker and striker head, to increase the speed of action of the fuze by reducing the inertia of the striker.

Mark 9 (cancelled)

Mark 10 (convtd. mark 3A or 8)

Differs from the mark 8 in the following respects:-

Thicker striker cover and smaller diameter striker head and the striker and striker head being of steel.

Mark 11 (convtd. mark 2) (obsolete)

Differs from mark 8 in the following respects:-

Thicker striker cover and smaller diameter striker head.

Steel striker and striker head.

Only one distance piece in the magazine recess.

Shutter of brass only and of a slightly different design.

Mark 12 (convtd. mark 3) (obsolete)

Differs from the mark 8 in the following respects:-

Thicker striker cover and smaller diameter striker head.

Steel striker and striker head.

Only one distance piece in magazine recess.

Mark 13 (convtd. mark 4) (obsolete)

Differs from the mark 8 in the following respects:-

Thicker striker cover and small diameter striker head.

Steel striker, striker head, guide bush, magazine and body.

Mark 14 (convtd. mark 8) (obsolescent)

Same as the mark 8 except for a thicker striker cover and smaller diameter striker head.

Mark 15

Similar to the mark 8 except that:-

The striker and striker head are of steel.

The striker cover is thicker and the striker head is of smaller diameter.

Mark 16 (obsolete)

Similar to the mark 10 except that it is assembled with a 5.7 gr. A.Z. tinned lugless detonator, in lieu of a 5 gr. A.Z. copper shell detonator.

Mark 17

Similar to the mark 15 except that it is assembled with a 5.7 gr. A.Z. tinned lugless detonator in lieu of a 5 gr. A.Z. copper shell detonator.

Mark 17/1

Similar to the mark 17, but body is provided with a shutter gauging hole.

Mark 18

Similar to the mark 17 differing principally in the shutter and locking weight being tin-plated all over and the face of the walls of the shutter recess and central hole guiding the striker and the top face of the magazine, projecting face of the distance hinge pin and the stop pins also being tin-plated. In addition, the body is provided with a shutter gauging hole.

Note:-

Mark 8 and earlier marks - Prior to 13/10/1942 an instructional label L139 with the legend "DO NOT REMOVE" was affixed to the striker cover, after this date this legend was embossed on the top of the striker cover which was manufactured to design F.D. 907.

Marks 10, 11, 12, 13, 14, 15, 16, 17 and 18 - These marks of fuzes are assembled with a striker cover to design D3/1/2214/E/341. The design called for a heavier gauge material than that used for covers to design F.D. 907, and the increase in thickness of the skirt made removal of the cover from the fuze impossible without the use of a special tool. Embossing the legend "DO NOT REMOVE" on top of the cover was, therefore, discontinued.

FUZE PERCUSSION, D. A. AND GRAZE NO. 119 AND NO. 119B

21. Type Perc., direct action and graze
22. Guns B.L. 9.2 inch gun (C.A.)  
B.L. 6 inch gun (C.A.)  
Q.F. 3.7 inch howr.  
Q.F. 25 pr. gun  
Not to be used in:-  
B.L. 4.5 inch gun  
B.L. 5.5 inch gun  
B.L. 7.2 inch howr.
23. Projectile H.E. shell

24. Description - No. 119B mark 17 (Fig. 57)

25. General - The fuze consists principally of a body, sleeve (inertia pellet) detonator plug, detonator holder, detent, centrifugal bolt, striker assembly, striker cover, safety cap, detonators and shutter assembly and magazine with cap.

26. Body - This is of brass and the lower portion is screw-threaded externally to the 2 inch fuze hole gauge. The upper conical portion has a flat top, a lateral threaded hole in the side for a plug to secure the centrifugal bolt and two key holes to take the key for inserting or removing the fuze. A lateral threaded hole in the lower threaded portion is for a pin to secure the magazine.

The body is bored from both top and bottom to leave a thick diaphragm with a hole drilled through the centre to act as a guide for the stem of the striker. The recess at the top houses the striker spring which is assembled under the head of the striker and also the striker cover.

The smaller central bore in the lower part of the body houses the creep spring which is assembled over the needle shank of the striker and rests on top of the detonator plug.

A slightly larger bore below this accommodates a spacing washer, followed by the detonator holder.

The lower bore contains the shutter assembly and magazine and is screw-threaded at the bottom to take the magazine.

On one side, off centre, a hole is drilled in the body to act as a vent to relieve the pressure in the middle portion of the body should a detonator fire on shock of discharge, while on the opposite side another hole is drilled to house the detent and detent spring.

27. Striker assembly - The striker is assembled from the lower part of the body. The striker spring is then assembled and compressed and retained in this position by fitting the striker head which is secured to the top of the striker by a retaining pin.

The centrifugal bolt is then assembled.

The creep spring is then assembled over the needle shank of the striker from the rear end of the body, followed by the sleeve. The creep spring, inertia pellet unit, and spacing washer are retained in position by the screwing home of the detonator holder.

28. Sleeve (inertia pellet) - This is cylindrical and is bored internally to accommodate at the rear end a 5 grain detonator and above this on a slightly larger diameter it is screw-threaded to engage the detonator plug. The top portion is then recessed and the rim chamfered to fit over the wider end of the spiral creep spring on assembly.

29. Detonator plug - This is cylindrical and formed with a threaded flange to screw into the sleeve. Internally a hole is drilled through the centre and acts as a housing and guide for the needle shank of the striker.

30. Centrifugal bolt - This is cylindrical with an undercut formed on the inner face. It is inserted in the hole in the side of the body and the head fits under a flange formed on the stem of the striker, thus locking the striker in the safe position.

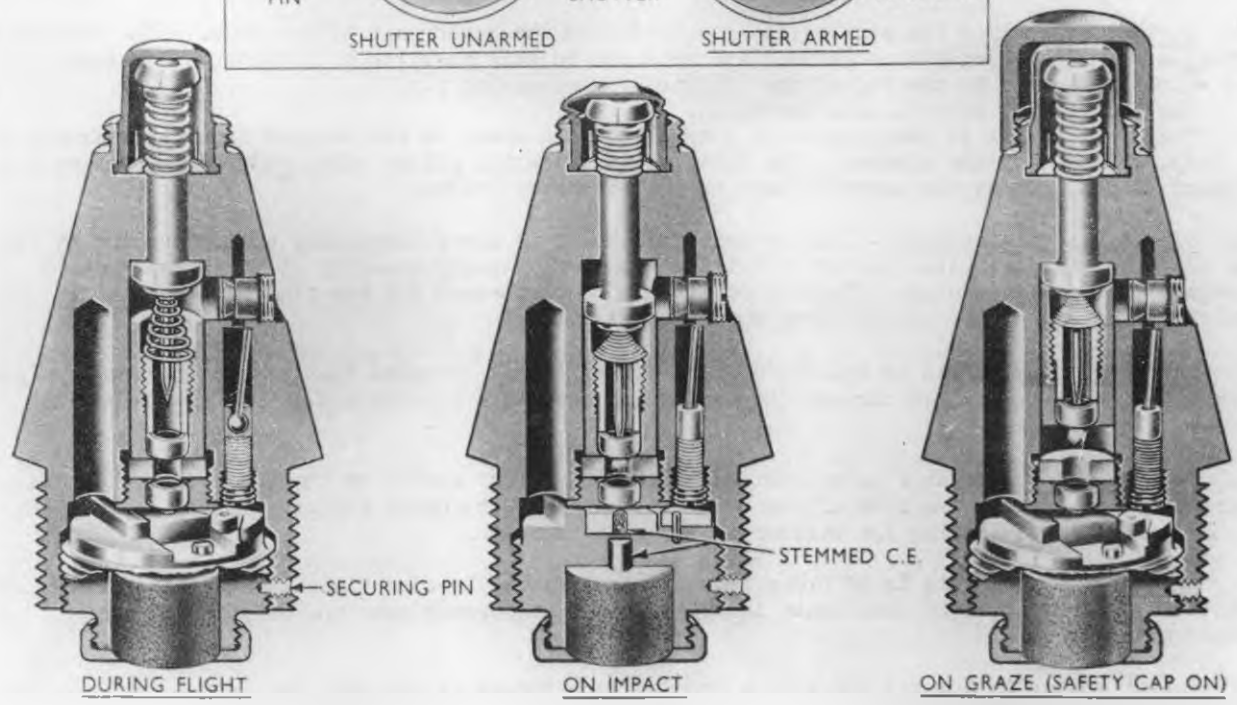
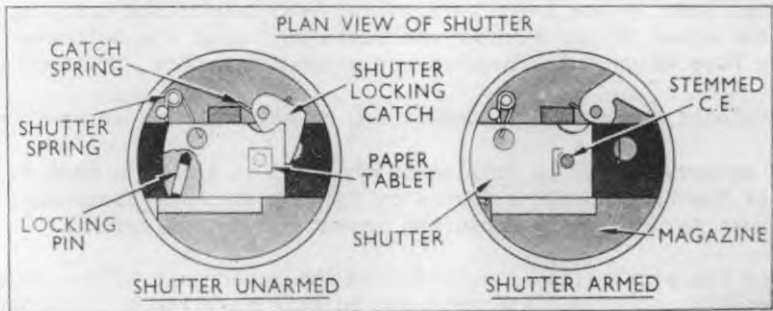
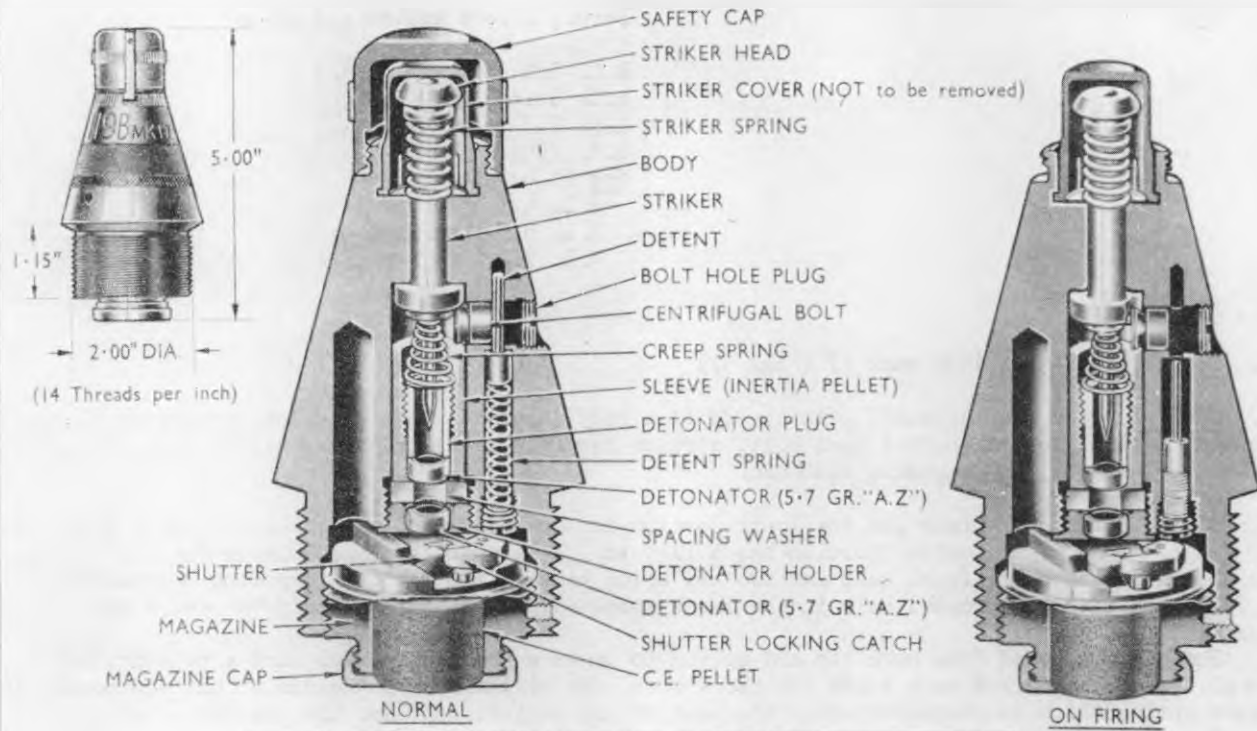
31. Bolt hole plug - This is of brass formed with a screw-threaded flange, and a screwdriver slot is made in the rear face to facilitate insertion. It is screwed into the body behind the centrifugal bolt.

32. Detent - This is a metal rod with a rounded knob formed at one end, the knob being loosely enclosed by a cylindrical weight.

The stem of detent is assembled behind the centrifugal bolt and prevents the bolt moving outwards until after the fuze is fired.

FUZE PERCUSSION, D.A., AND GRAZE, No. 119B, MARK 17

FIG. 57



33. Detent spring - This is a spiral of spring wire assembled below the detent. Set back of the detent on acceleration compresses the spring and the stem of the detent becomes locked under the shoulder formed in the detent hole in the body.
34. Striker - The aluminium alloy striker has a separate mushroom shaped head secured by a split pin.  
The striker spindle is circular in section, having a sharp point formed at its lower end above which a shaped flange formed to make a seating against the diaphragm in the body of the fuze. Above the flange the stem of the striker is thickened, the upper end being reduced in diameter to fit the head and bored to take a split pin.  
The striker head is bored centrally to fit the striker and radially for the split pin.
35. Striker spring - This is a spiral of steel wire assembled under initial compression between the striker head and the upper surface of the fuze body.
36. Creep spring - This is a cone of steel wire assembled under light compression between the top of the detonator plug and under the flange formed above the needle shank of the striker.
37. Shutter - This comprises a sliding block, locking pin, shutter spring, catch spring and a shutter locking catch.  
When the shell leaves the muzzle the shutter locking catch spins outwards under centrifugal force permitting the shutter (or block) to slide outwards in the armed position where it is retained by the locking pin.
38. Detonator (upper) - This is a 5.7 gr. AZ tinned lugless detonator.
39. Detonator (lower) - This is similar to the former, and is housed in the detonator holder and secured by ringing.
40. Detonator holder  
This is circular and screw-threaded externally to engage in the body. Internally it is recessed to house the 5 grain detonator.
41. Magazine - This is of brass. The main upper portion is screw-threaded externally to suit the body whilst the bottom part is reduced in diameter for the cap. It is secured in the body by a pin.  
The magazine is bored from the base in two diameters, the larger bore containing a C.E. pellet, which is assembled with the hard end nearest to the bottom cap. The smaller bore terminates in a diaphragm from 0.003 to 0.008 of an inch thick and is filled with stemmed C.E. A recess is formed in the opposite end to house the shutter assembly.
42. Magazine cap - This is screw-threaded internally to suit the base of the magazine. It screws over the bottom of the magazine and retains the C.E. pellet. After filling, the cap is crimped in two or more places to prevent it unscrewing.
43. Striker cover - This brass dome-shaped cover fits over the striker head and is secured by the bottom ridged edge being sprung into an annular groove at the bottom of the recess formed in the top of the body.  
The cover prevents air resistance during flight from acting on the striker head to cause premature action of the striker.  
This cover must not be removed when preparing for loading.
44. Safety cap - This black-painted steel dome-shaped cap has a flat steel spring riveted into an oblique slot in the side. The free end of the spring engages the milling on the body of the fuze and retains the cap in position. The cap has a milled ring around its circumference and is screw-threaded internally at the lower end for attachment to the top of the fuze body.  
The cap may be removed before firing, but NOT the striker cover underneath.
45. Safety arrangements - The following safety arrangements are incorporated:-
- (a) Safety cap which protects the striker cover and striker head from accidental damage.
  - (b) Centrifugal bolt which holds the striker by the edge of the flange and thus prevents the whole striker moving backwards.
  - (c) The creep spring which keeps the striker and inertia pellet apart.
  - (d) The safety shutter which prevents the main detonator firing the magazine, if accidentally detonated, by the interpolation of the solid part of the shutter between the two.

46. To prepare the fuze for firing - The steel cap must not be removed from the fuze until the shell to which it is fitted, is prepared for loading. It may then be removed, or allowed to remain in position, the decision depending upon the nature of the target about to be engaged. The brass striker cover under the cap is never to be removed.

47. Action - on firing - Due to acceleration of the projectile, the striker and detent set back compressing the creep and detent springs respectively, until the shaped portion under the surface of the flange formed around the striker engages a similarly shaped portion of the centrifugal bolt, thus preventing its movement and the stem of the detent sets back and is retained under the shoulder in the detent bore. The shutter remains in the unarmed position, due to friction caused by set back, thus ensuring safety in the bore should either of the detonators function prematurely.

48. During flight - When acceleration ceases the striker moves forward under the action of the striker spring helped by the creep spring, and centrifugal force now causes the locking catch to swing outwards to release the shutter. Further rotation of the projectile causes the shutter and the released centrifugal bolt to move outwards, the former bringing a channel, filled with stemmed C.E. into alignment with the detonators in the fuze. When the shutter arrives in this position centrifugal force causes the locking pin in the side of the shutter to come out of its recess and catch behind a lug in the magazine, so retaining the shutter in the armed position. The sleeve now has a tendency to creep forward due to acceleration, but this tendency is resisted and checked by the creep spring.

49. On impact (cap off) - The fuze usually functions by direct action, the striker being driven inwards and its point piercing the detonator in the sleeve. The resulting flash causes the lower detonator to function and a detonating wave passes via the stemmed C.E. in the channels of the shutter and magazine to the C.E. pellet in the latter and thence to the bursting charge in the shell.

If, due to the small angle of arrival or other causes, the striker is not driven in, the fuze will function by graze action, as described below.

50. On impact (cap on) - Against light cover the striker is rendered inoperative by the presence of the cap, and the fuze will function by graze action. When this happens the sleeve with its detonator moves forward on to the point of the striker, immediately the projectile is retarded, and the detonator is fired.

Except for a slight delay that is inherent in fuzes functioned by graze action, all subsequent events are as previously described.

NOTE:- The No. 119 fuze is distinguishable from the No. 117 by having two bands around the body, one knurled and the other coloured black.

51. Difference in marks - The following shows briefly the various differences in patterns:-

No. 119, mark 11

This is a mark 3A or 4 No. 119 fuze converted by fitting a new magazine, new type of lock shutter, a weaker (20 oz.) creep spring and a flanged detonator holder. After 12-2-46 the 5 grain A.S.A. main detonator was replaced by a 5 grain AZ detonator.

No. 119B

Mark 10 (obsolescent)

This is similar to the No. 119B mark 4 fuze but with new design magazine in zinc alloy with lock shut shutter, and striker with striker head raising spring. After 12-2-46 the 5 grain A.S.A. main detonator was replaced by a 5 grain AZ detonator.

Mark 11

This is a mark 1 No. 119B fuze converted in a similar manner to the mark 11 No. 119 fuze. It differs from the mark 10 in not having a striker head raising spring, and in having a 3 gr. "A" instead of a 5 gr. AZ detonator in the inertia pellet. After 12-2-46 the 5 grain A.S.A. main detonator was replaced by a 5 grain AZ detonator.

Marks 12 and 13

These "marks" have been allotted to an Indian design.

Mark 14

This is a mark 10 No. 119B fuze, converted by being fitted with a brass magazine, modified shutter and strengthened head and cover.

Mark 15

Allotment of "mark" held in abeyance. No design prepared.

Mark 16

This "mark" has been allotted to an Indian design

Mark 17 - (as described above)

This is identical with the mark 14 except that it is fitted with a 5.7 grain A.Z. tinned lugless detonator, in lieu of a 5 gr. AZ copper shell detonator.

Note: No. 119 mark 11 and No. 119B marks 10 and 11 fuzes

Prior to 13/10/1942 an instructional label L139 with the legend "DO NOT REMOVE" was affixed to the striker cover, after this date this legend was embossed on the top of the striker cover which was manufactured to design F.D.907.

Prior to 28/8/1942 an instructional label L508 with the legend "THE CAP SHOULD BE LEFT ON WHEN THE TARGET IS BEHIND COVER", was affixed around the safety cap. After this date its application was discontinued.

No. 119B marks 14 and 17 fuzes

These marks of fuzes are assembled with a striker cover to design D3/L/2214/E/341. The design called for a heavier gauge material than that used for covers to design F.D.907, and the use of a special tool. Embossing the legend "DO NOT REMOVE" on top of the cover was, therefore, discontinued.

FUZE, TIME AND PERCUSSION, D.A., NO. 213

52. Type Time, mechanical and perc. D.A.
53. Guns 3.7 inch howr.  
25 pr. gun  
4.5 gum  
5.5 gum  
7.2 howr.
54. Projectile H.E. shell
55. Description - Mark 4 (Fig. 58)

56. General - This fuze is fitted with a mechanical timing which is operated by a main spring and controlled by an escapement. The time of bursting the shell can be varied between 0 and 80 seconds after the gun is fired. The upper part of the fuze is arranged for direct percussion action on impact.

The fuze consists principally of a body, dome, head, locking weight, striker head with needle, detonator holders (upper and lower), pellet holder, shutter, magazine and cap, tensioning ring, mechanism, time, 80 seconds, No. 1 and safety cap.

The exterior of the body is threaded at the bottom to screw into the nose of the shell maintained by the dome and lower portion of the head of the fuze, the upper portion of the head being shaped to range the same as the No. 117 and 119 (cap off) fuzes.

The interior of the body is divided by a platform. The upper part contains the movement, a recess in the underside of the platform takes the lower 5 gr. A.Z. detonator holder, and the bottom part contains the shutter and magazine.

The dome covers the top of the clock and can be rotated in the fuze body. The dome is retained by a spring tensioning ring which fits in an internal groove near the foot of the dome. Inside the head of the fuze is a locking weight. Set back of the weight on firing breaks the shear wires and drives in locking pins to jam the dome in the body and to lock the dome as set. Beneath the locking weight is a platform or hand race, across which a shaped slot is cut. Rotation of the dome positions the slot and thereby sets the fuze.

The clockwork mechanism rotates a spring-loaded hand beneath the hand race, and is driven by a mainspring and controlled by an escapement through a train of gear wheels.

The clockwork mechanism is started by firing the gun, the hand being released for rotation by the set back of a trigger.

57. Clockwork mechanism - The clock is assembled as a complete unit and fixed to the top of the platform in the fuze body.

The mechanism, time, 80 seconds, No. 1 is similar in operation to the mechanism, time, 43 seconds described in the 208 fuze.

58. Head - The head is shaped to suit the contour of the fuze dome, into which it screws. The top is screw-threaded externally to suit the safety cap.

Internally it is bored from the bottom to accommodate the locking weight, a pellet holder and on a smaller diameter to accommodate the detonator holder (upper). While from the top it is bored to accommodate the striker cup and striker head with needle. After assembly of the striker the recess in the top of the head is closed by a closing disc and washer which are secured by turning over a lip formed in the top of the head.

59. Body - This is formed with a shoulder below which it is screw-threaded to the 2 inch fuze-hole gauge. Above the shoulder is an inclined surface graduated "0" to "80" with a safety mark engraved and filled in with red in the space between the figures 80 and 0.

Internally the body contains the clockwork mechanism in the upper part and below this is a detonator. A slot in the top of the magazine houses a movable shutter retained in the unarmed or safe position by a steel spring.

60. Striker - This consists of a striker head and needle. The needle being formed with a flange which seats in a recess formed in the striker head in which it is secured by turning over a lip.

The striker is held off the upper percussion detonator by a striker cup through the centre of which the needle protrudes.

61. Detonator holder (upper) - This cylindrical brass holder has a flange formed at the base. Internally the top is recessed to take the 5.7 gr. A.Z. detonator and below this it is bored to form a fire channel.

It is inserted in the fuze head from underneath, with the detonator immediately beneath the striker needle.



62. Detonator holder (lower) - This is assembled off centre on the underside of the platform and above the sliding shutter. The holder is recessed to accommodate a 5.7 gr. A.Z. detonator which is secured in position by burring over a lip formed on the holder. A hole is bored through the bottom of the detonator recess to permit the flash from the detonator passing on to the oblique channel in the shutter when in the armed position.

63. Pellet holder - This is of aluminium alloy cylindrical in shape. Externally it is screw-threaded at the top, and a hole is formed in the base. It contains a perforated gun-powder pellet. It is assembled in the head below the flange on the detonator holder (upper).

64. Shutter - The brass shutter slides in a slot on top of the magazine. At one end is an oblique channel filled with C.E. stemmed in. A small hole in the side takes the end of a steel shutter spring which pivots on a dowel pin and keeps the shutter at the centre in the unarmed or safe position. In this position the oblique channel is clear of both the detonator and magazine channel.

When the shell is in flight, centrifugal force overcomes the spring and pulls the shutter outwards to the open or armed position.

In this position the lower detonator, shutter channel, and magazine channel are all in line.

65. Detonators - These are both 5.7 gr. AZ tinned lugless detonators.

66. Magazine securing ring - This is a brass collar screw-threaded on the outside to enter the fuze body from underneath. It surrounds the magazine and secures it by bearing on the under surface of the flange formed on the upper part of the magazine. The ring is secured by a set screw inserted from the side of the threaded portion near the bottom of the fuze body.

Four slots at the bottom are for an assembly tool.

67. Magazine - This is of brass and is screw-threaded externally at the bottom to take a bottom cap. It is bored from the underside to form a recess to take a C.E. pellet, the pellet being retained in position by the bottom cap.

A flange is formed towards the top of the magazine, the under surface of which forms a bearing for the magazine securing ring. The top forms a platform for the shutter assembly.

A slot across the top accommodates the sliding shutter. A dowel pin in the recess forms a pivot for the shutter spring and another positions the magazine to the fuze body platform.

A small channel off centre, with a diaphragm of metal left at the top, leads from the shutter slot to the recess in the magazine. It is filled with C.E. stemmed in.

The magazine is held in position by the magazine securing ring.

68. Bottom cap - This may be of brass, aluminium alloy or steel, and is threaded internally. It screws over the bottom of the magazine and retains the C.E. pellet. After filling the magazine, the cap is screwed on and then crimped in two or more places to prevent it unscrewing.

69. Safety cap - This is of steel or malleable cast iron, dome shaped and has a flat steel spring riveted into an oblique slot on one side. The free end of the spring engages in the milling on the head of the fuze and retains the cap in position. The cap is formed with milled ring around its circumference and is screw-threaded internally at its lower end for engagement with the threads formed on top of the fuze head.

The cap is painted or lacquered black externally.

70. Safety Arrangements - The following safety arrangements are incorporated:-

(a) When the fuze is set at SAFE, the hand race in the dome is coincident with the hand which is prevented from rising by the muzzle safety device bridge.

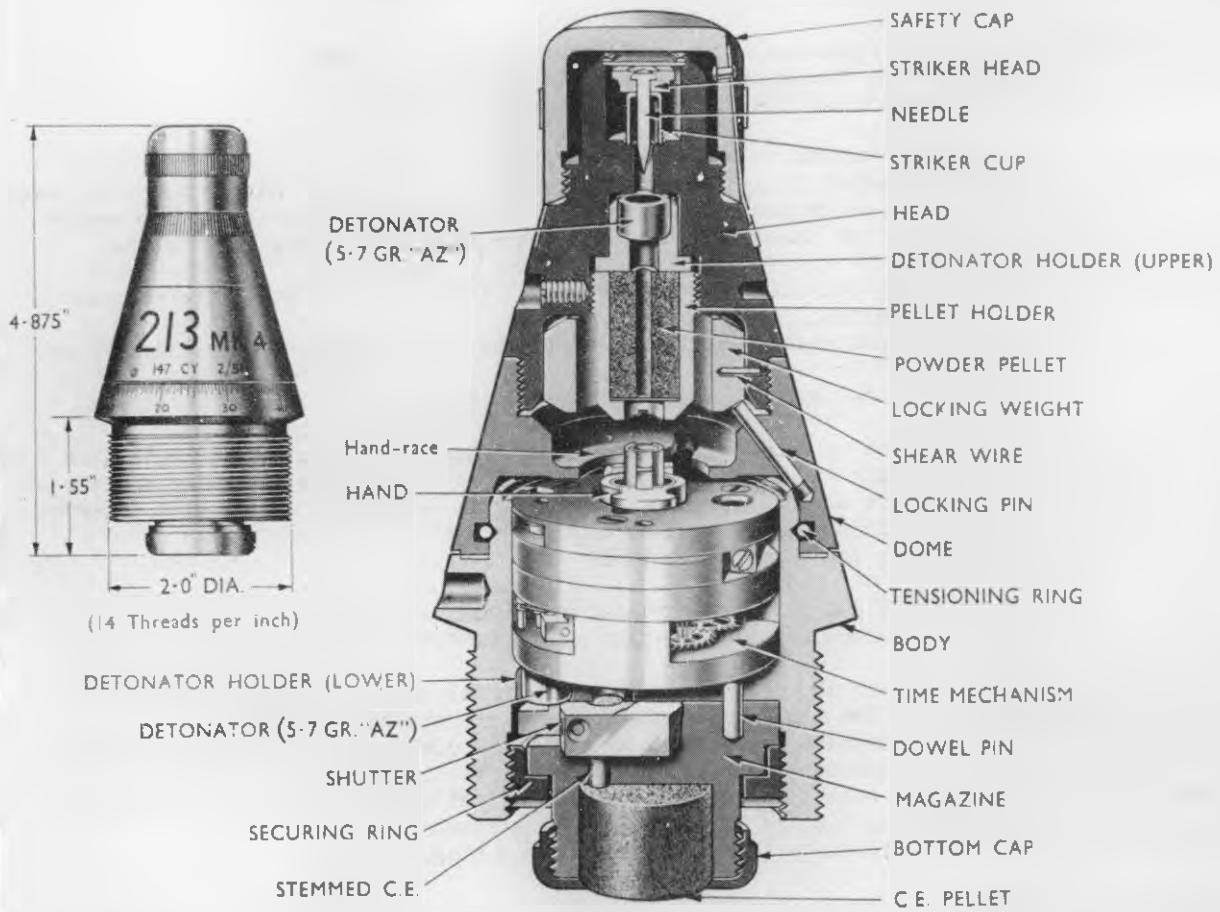
(b) The tensioning ring prevents the dome being accidentally moved during transit.

(c) The centrifugal safety catch is housed under the striker cam until the shell rotates in flight. It serves a dual purpose:-

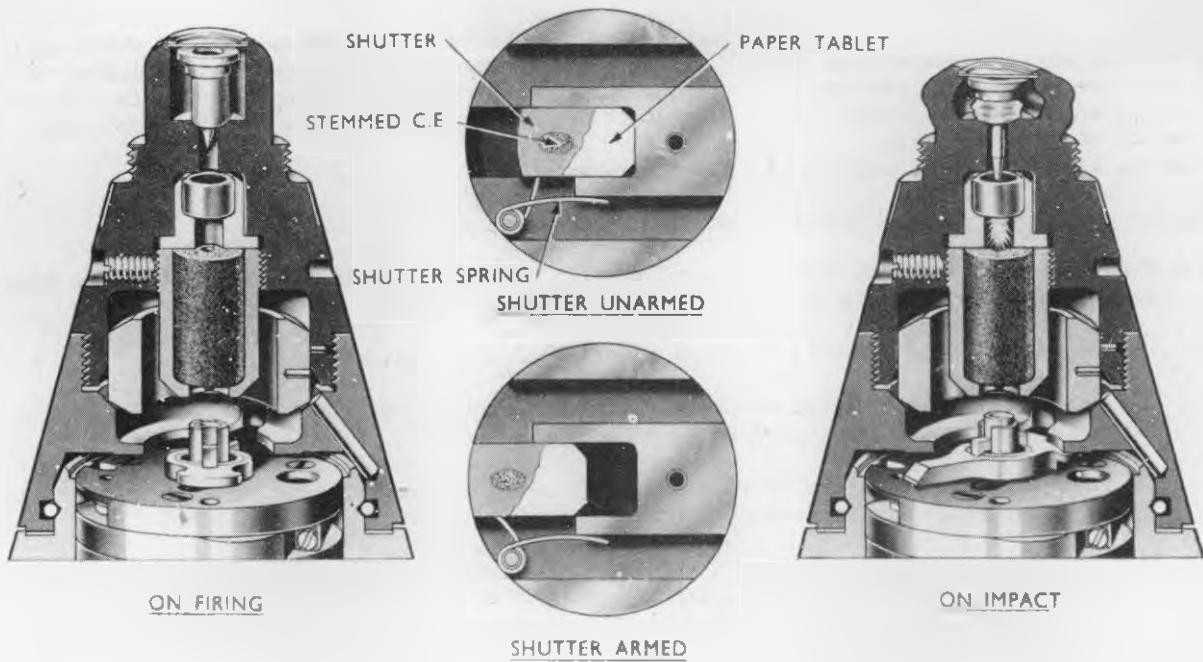
(i) In the event of the clockwork mechanism being accidentally set in action, the catch prevents the striker reaching the detonator.

(ii) If a fuze with the clockwork mechanism accidentally set in action was loaded and the gun fired, the centrifugal safety catch would be prevented from swinging out from under the cam as the latter would, immediately the hand is lifted, jam down on to a step cut in the catch for this purpose.

FUZE, TIME AND PERCUSSION, D.A., No.213, MARK 4



NORMAL



ON FIRING

SHUTTER ARMED

ON IMPACT

71. Action of timing mechanism - Prior to loading, the fuze is set to the time required, and the safety cap removed.

72. On firing - The locking weight in the head sets back, shearing the copper pins and forcing the locking pins into recesses in the body thus locking the dome to the body and preventing any movement of the dome from the set position.

The trigger sets back and the trigger locking bolt is forced outward by its spring to retain the trigger. The hand is now released from the trigger, but prevented from rising by the muzzle safety device bridge.

During acceleration in the bore it is unlikely that the pallet will oscillate owing to the force of the set back. When the muzzle is reached the hand begins to rotate in an anti-clockwise direction by the action of the main spring.

On acceleration ceasing the centrifugal safety catch flies outwards, due to centrifugal force, and leaves the striker supported by its cam resting on the pillar.

73. During flight - The shutter moves outwards against its springs, by centrifugal force, bringing the fire channel coincident with the lower detonator and the channel leading to the magazine.

When the clockwork mechanism has run the prescribed time according to the setting, the hand has been brought immediately under the slots in the hand race and rises under the influence of its spring to release the lever which controls the striker. The release of the lever allows the spring to rotate the cam off the pillar and force the striker down on the detonator.

The striker is forced by its spring into the detonator, which fires. The flash passing through the stemmed C.E. channel in the shutter to the C.E. pellet in the magazine.

74. Action of Percussion Arrangement - On firing - The acceleration of the shell in the bore causes the shutter to set back and set up sufficient friction in its recess to retain the shutter in the unarmed position whilst the shell is in the bore.

75. During flight - When acceleration ceases, the shutter moves forward by momentum and outward by centrifugal force, to bring its fire channel coincident with the lower detonator and the channel to the magazine.

76. On impact - The cap having been removed before loading, the striker head is crushed in and the needle pierces and fires the upper detonator. The resultant wave explodes the gunpowder pellet, the flash from which passes through the dome and fuze body to detonate the lower (time) detonator. The action is then described under action of timing mechanism.

77. Differences in marks - The following shows briefly the various differences in patterns:-

Mark 1 (obsolescent)

Mark 2

The mark 2 fuze is similar to the mark 1 differing chiefly in the former incorporating an internal locking device, the tensioning screws requiring less pressure; the pellet holder being secured by a set screw and magazine assembly secured by a copper securing pin.

Mark 3

Differs from the mark 2 in being fitted with two 5.7 gr. A.Z. tinned lugless detonators in lieu of two 5 grain AZ copper shell detonators.

Mark 4

(described above)

Identical to the mark 3 except that the body (magazine cavity), pins, detonator holder (upper and lower), magazine (top face), securing ring, striker cup and detonator washer are tin-plated.

FUZE, TIME AND PERCUSSION GRAZE NO. 221 AND NO. 221B

78. Type Time and percn., graze
79. Guns Q.F. 25 pr. gun  
Q.F. 3.7 inch howr.  
E.L. 5.5 inch gun
80. Projectile B.E., smoke, flare and chemical shell
81. Description - No. 221B Mk. 4 (Fig. 59)

82. General - The fuze is a double banked tension fuze of metal fitted with a brass cover. The standard time of burning under normal atmospheric conditions is  $49\frac{1}{2}$  seconds.

It consists of a body, bottom and top rings, cap, base plug, time needle pellet with needle and spring, percussion needle pellet with needle and creep spring, detent, detent spring and centrifugal bolt.

83. Body - This is formed with a flange or platform, below which it is screw-threaded to the 2 inch fuze-hole gauge. Above the platform is formed a short stem having the top reduced in diameter and screw-threaded externally to receive the cap. The flange of the body is graduated around its outer edge from 0 to 22. On the ungraduated portion between the figures 28 and 0 a safety mark is engraved with the word "SAFE" engraved beneath it.

The stem is bored centrally from the top to receive the percussion arrangements and screw-threaded to receive the detonator holder and plug. An additional boring to one side of the central channel contains the time arrangement and time detonator, and is connected to the port on the outside of the stem by two oblique flash holes. The lower part of the body is bored and recessed to form a magazine, and has an oblique and vertical channel connecting the magazine with the top of the platform and the bottom time ring. The channels contain perforated powder pellets.

A recess in the stem bored through the base receives the detent and detent spring and is closed by a screwed plug. A horizontal recess bored through from the side of the stem and connecting with the detent recess, contains the centrifugal bolt, the latter locking the percussion arrangement in the safe position. The centrifugal bolt is prevented from removing outwards by the detent and spring.

Key holes are formed in the side of the platform for fixing purposes.

84. Bottom Ring - This is bevelled on the outer edge and has a concentric groove filled in with RD 202 pressed fuze powder nearly all round its under surface, a small recess being bored in the top surface coincident with the commencement of the groove and containing a perforated powder pellet. An oblique channel connects the powder pellet and the fuze powder.

A gas escape, having a perforated powder pellet, is provided in the outer edge. The ring is assembled over the stem of the body, round which it is free to revolve for setting purposes. The ring is lacquered red.

85. Top ring - This is similar to the bottom, but is of a smaller diameter. The oblique channel leading from the concentric groove passes to the inner surface of the ring, and, when the ring is assembled over the stem, the end of the channel is positioned to register with the port in the side of the stem. The ring is prevented from turning by a brass pin fitting into corresponding semi-circular recesses cut in the ring and stem. The concentric groove is filled with 30 second fuze powder.

86. Cap - This is of aluminium, cone shaped, bored and screw-threaded to fit over the stem of the body. Two key recesses are formed in the sides for tightening the cap until sufficient tension is applied to the bottom ring. It is secured in position by two set-screws.

87. Base Plug - This has a central perforation which is closed by a brass washer and paper disc shellacked together.

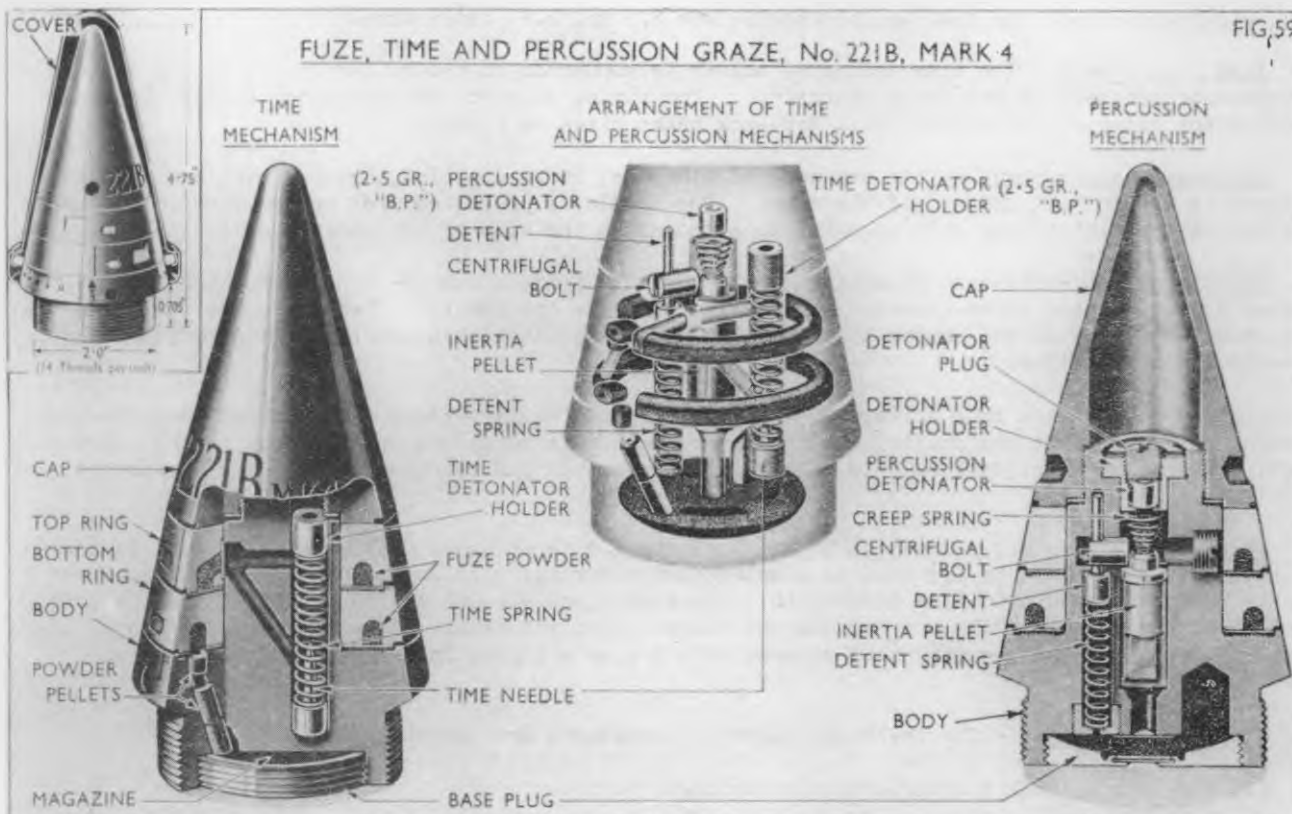
88. Magazine - The magazine is filled with 60 grains of G.20 gunpowder and is then closed by the base plug.

89. Washer for sealing joint between shell and fuze - A steel "washer, self-centring, 2.3 inch" or "washer, copper and asbestos, 2.3 inch" is fitted under the flange of the fuze to make a water-proof seating between the fuze and lip of the shell.

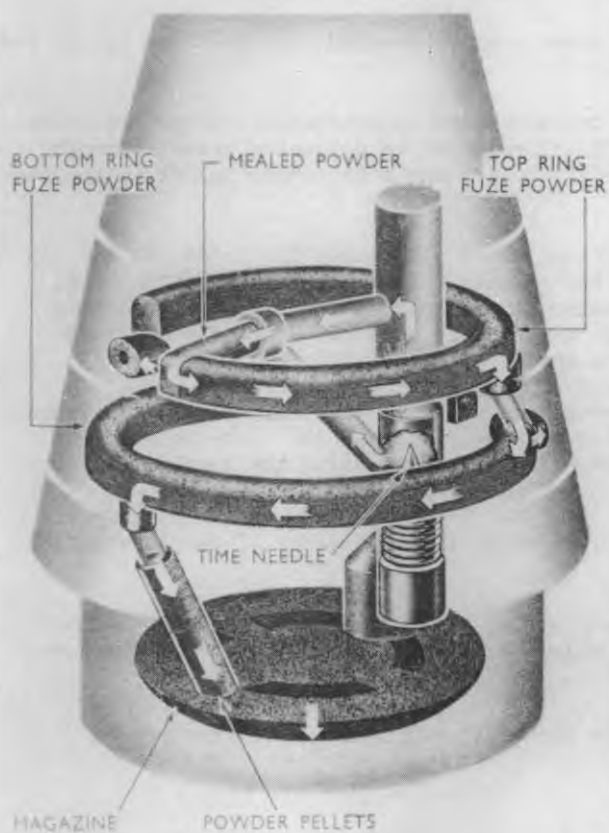
NOTE: This applies only to No. 221B marks 1, 2 and 3 fuzes. It is not used with fuzes manufactured with a stepped shoulder

### FUZE, TIME AND PERCUSSION GRAZE, No. 221B, MARK 4

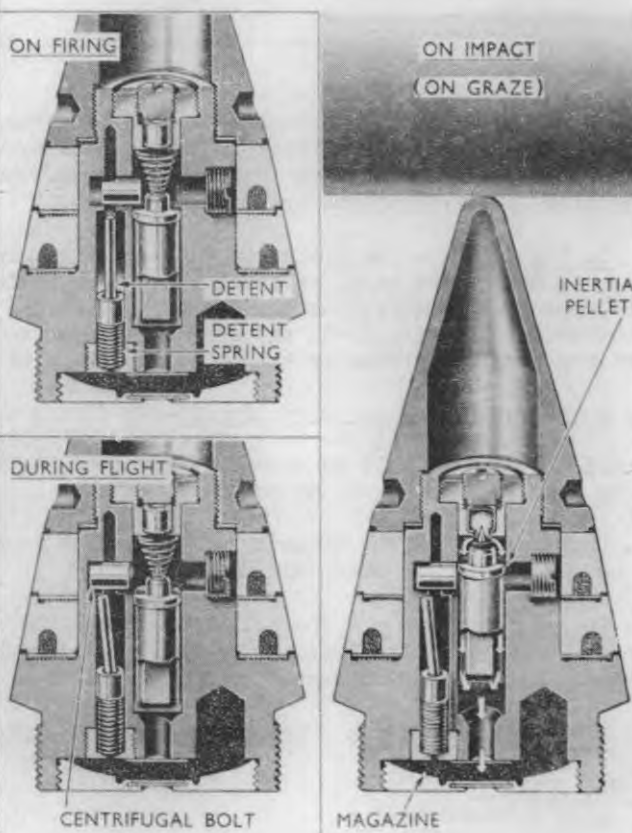
FIG. 59



ACTION OF TIME MECHANISM



ACTION OF PERCUSSION MECHANISM



90. Detonators - Both the time and percussion are 2.5 gr. B.P. detonators.

91. Time arrangement - The time detonator holder is supported on the coiled spiral spring and has the underside recessed to receive a detonator. The spring supports the detonator holder, keeping the detonator clear of the needle until set back takes place on firing.

92. Percussion arrangement - This consists of a needle, inertia pellet, creep spring and detonator contained in the central channel of the stem. The needle is prevented from moving forward by the inner end of the centrifugal bolt engaging in a recess in the side of the inertia pellet.

93. Inertia pellet - This is cylindrical, with a flange formed near the top above which the diameter is reduced and screw-threaded internally to engage the needle. Two slots are formed in the sides from the flange to the bottom of the pellet to act as flash channels from the percussion detonator to the magazine.

94. Creep spring - This is a spiral steel wire spring. The larger end is assembled under the detonator holder, whilst the smaller end fits over the needle point and rests on top of the inertia pellet. When the centrifugal bolt is disengaged it prevents the inertia pellet creeping forward on to the detonator.

95. Cover - This is a No. 5 Cover to T. and P. Fuzes and is of brass, fitted with a round rubber ring at its lower end and is provided as a waterproof covering. It is coned shaped and assembled over the fuze, being secured by a band which is pressed tightly round the fuze, and secured by soft copper wire, the ends of which are twisted and tucked under the band. Alternatively, the cover may be held in position by a securing band secured by a tongue engaging in a slot, the tongue being turned over.

96. Safety arrangements - The following safety arrangements are incorporated:-

- (a) The inertia pellet is held by a centrifugal bolt.
- (b) The resistance of the spiral spring keeps the time pellet clear of the striker.
- (c) When set "safe" the top ring is masked from the magazine time detonator.

97. Action of time arrangement - Before loading, the cover must be removed, and the fuze set to the time required.

98. On firing - The time detonator holder sets back, overcomes the resistance of the coiled spiral spring, and carries the detonator on to the needle. The flame from the detonator passes through the flash holes in the stem to the top time ring, where it ignites the fuze powder pellet in the gas escape hole, blowing out the brass disc.

99. During flight - The powder in the top ring burns round until it reaches the recess in the top surface of the bottom ring, explodes the powder pellet and ignites the powder in the bottom ring, at the same time clearing the gas escape hole. The powder burns round in the opposite direction to that of the top ring until the channel leading to the magazine is reached. The flash passes to the magazine and thence to the bursting charge of the shell.

100. Action of percussion arrangement - On firing - The acceleration of the shell causes the detent to set back, compressing the detent spring, and releasing the centrifugal bolt. The rotation of the shell causes the bolt to move outwards from its recess in the body leaving the inertia pellet free to move forward on impact or graze.

101. During flight - The tendency of the pellet to move forward, in consequence of deceleration, will be checked by the creep spring.

102. On impact or graze - The pellet overcomes the creep spring and carries the needle on to the detonator. The resultant flash passes through to the magazine which is exploded, should the time arrangement not have functioned during flight.

103. Differences in marks - The following shows briefly the various differences in patterns:-

Fuze No. 221

Mark 1 (obsolete)

Mark 1\* (obsolete)

Differs from mark 1 by their needles being secured to prevent them becoming loose in the inertia pellets. These fuses were modified in 1942.

Mark 2 (obsolete)

Differs from the mark 1 in being fitted with a plastic cap, in having a stepped shoulder and therefore requires no washer.

Mark 2\* (obsolete)

Differs from mark 2 by their needles being secured to prevent them becoming loose in the inertia pellets. These fuzes were modified in 1942.

Fuze No. 221B

Mark 1 (obsolescent)

Similar to the mark 1 No. 221 but is fitted with a weaker detent spring.

Mark 2 (obsolescent)

Similar to the mark 2 No. 221 but is fitted with a weaker detent spring.

Mark 3

This is of new manufacture. It differs from the mark 1 No. 221B fuze in having:-

- (a) Weaker detent spring (2 lb.  $1\frac{1}{2}$  oz. instead of 3 lb. 6 oz.).
- (b) New magazine base plug without upstands.
- (c) Shorter inertia pellet having a guide band at each end.
- (d) A new percussion detonator holder and plug to bring the detonator lower in the fuze body.
- (e) A conical instead of a cylindrical creep spring.
- (f) The top cap (of aluminium alloy only) re-designed so that the grub-screw bears directly on the body.

The grub-screw is inserted, after tensioning, in the hole nearer to the 22 graduation to ensure that the point of the screw does not enter the gash for the time detonator holder. After 15/9/43 the grub screw holes in the cap were counterbored so that the second hole could be closed by a screwed plug.

Mark 4 (described above)

Similar to the mark 3 but has a stepped shoulder.

After 22/6/42 the two piece time needle was deleted.

The upstands on the magazine base-plug were omitted after 30/6/42 and the diameter of the filling hole increased after 15/2/43 to facilitate filling. After 23/11/44 a new base plug without a filling hole was fitted.

After 30/1/43 the tension required to turn the bottom ring was increased from 250  $\pm$  20 to 450  $\pm$  50 inch/ozs.

After 11/8/43 the alternative cap of plastic was deleted.

After 20/9/43 the depth of the bore for the centrifugal bolt and the length of the bolt were amended to increase the clearance from the inertia pellet in the armed position by .040 inch.

NOTE:- From 9/6/49 approval was given for the omission of the distinctive red lacquering (denoting slow burning composition) from the lower rings.

Fuze No. 221T (obsolete)

Mark 1

These are modified No. 221 fuzes.

The modification consists of the removal of the percussion detonator and plug.

The letter "T" is stencilled in blue on the top cap and cover.

FUZE, PERCUSSION, BASE, MEDIUM L15

104. Type Pero., base, medium with delayed arming shutter
105. Guns Q.F. 25 pr. gun; 120 mm. L1 and L2 guns
106. Projectile H.E. shell
107. Description - Model A1 (Fig. 60).

108. General - The fuze consists principally of a body, magazine and cap, striker assembly, creep spring, striker locking segment and delayed arming shutter No. 3 containing a 2.8 grain "AZ" detonator.

109. Body - This is of aluminium alloy - anodised all over. It is cylindrical in shape with a wide flange formed at the base above which it is screw-threaded externally to 1.80 L.H. gauge for approximately a quarter of its length, the remainder of the body being left plain. A hole is drilled in the centre of the base and screw-threaded to accept a tracer-adaptor (120 mm. shell only). Two key holes diagonally opposite are also formed in the base to enable the fuze to be inserted or removed from the shell.

Internally, the body is bored from the top in four diameters, the smaller at the base to accommodate the striker and creep spring, the second and third, which are slightly larger in diameter, accommodates the striker locking segment, whilst the fourth and largest is screw-threaded at the mouth. This larger recess accommodates the delayed arming shutter above which the magazine is screwed home.

The base and flange of the body is coated with varnish after the marking has been stamped on.

110. Striker - This consists of a brass electro-tinned cylindrical body, with a flange at the base above which it is formed on three decreasing diameters, a recess being formed in the top of the smallest diameter for the electro-plated tin or zinc coated steel needle, the stem of which protrudes through the centre of the striker locking segment. The needle, the base of which is flanged, is retained in the recess in the top of the body by a tin coated brass washer which is secured by spinning over a lip at the top of the recess. The needle is free to move sideways in its recess.

The striker is inserted into the cavity in the base of the fuze body together with the creep spring which is assembled around the larger diameter of the striker body, the bottom coil resting on the flange. The creep spring is retained under initial compression by the top coil seating in a recess and bearing against the base of the striker locking segment.

111. Creep spring - This is cylindrical coiled tinned steel wire spring, with four effective coils of .056 dia. wire, one coil at each end being close coiled and ground square with the axis of the spring. It is assembled round the larger diameter of the striker body and prevents the assembled striker creeping forward when the shell is in flight.

112. Striker locking segment - This is assembled in the fuze body, the lower portion fitting over the top of the striker. It is retained in position by a screw inserted through the side of the fuze body, the shank of which bears on the striker locking segment cover.

The striker locking segment comprises a holder, two electro tin plated steel pins, two springs, two segments, a washer and a cover.

113. Holder - This is of aluminium alloy, cylindrical in shape. Externally it is formed in two diameters, the larger being at the top. The bottom portion of the larger diameter is chamfered to blend with the smaller. The bottom of the smaller diameter is also chamfered.

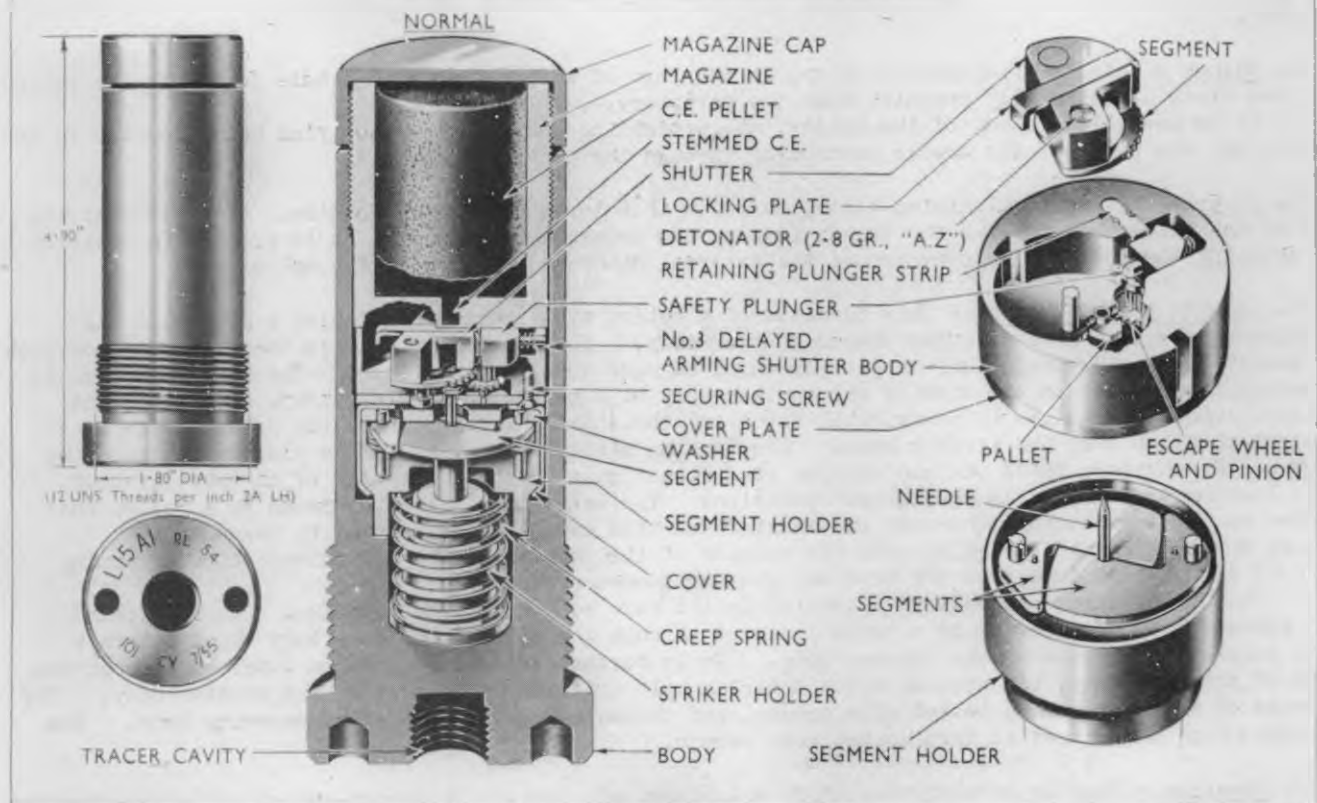
Internally, from the base it is bored out in two diameters, whilst a recess is formed in the top face to house the two locking segments, leaving a platform of metal between the top and bottom. A hole, the lower edge of which is chamfered, is drilled through the centre of the platform to permit the striker to pass through. In the base of the recess in the top of the holder, near the periphery, two holes diametrically opposite are drilled to accept the steel pins over which are assembled the coiled springs and the segments. When assembled, the tops of the two pins protrude above the top surface of the holder.

114. Segments - These are of aluminium alloy, and are perfectly flat irregular arc-shaped fittings. One end is in the form of a toe which is machined to act as a working surface when the two segments are assembled in the unarmed or locked position, the other end is wider and acts as a weight which, under the influence of centrifugal force, overcomes the springs and allows the two segments to open out. Two holes are drilled near the toe, the larger to fit over the pin on which the segment pivots, the smaller accommodating the turned up end of the segment spring. In the closed or unarmed position the top portion of the striker bears against the underside of the closed segments, and thus the striker is prevented from moving forward until the segments are opened by centrifugal force.

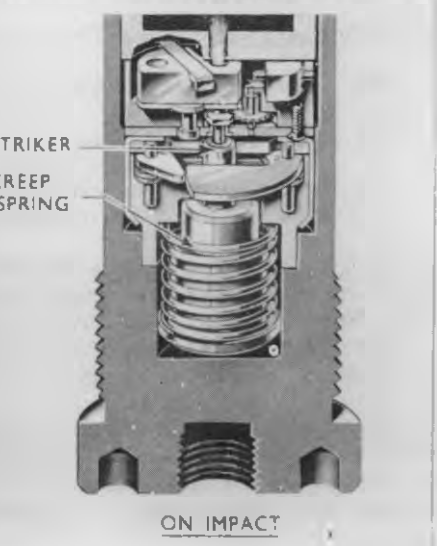
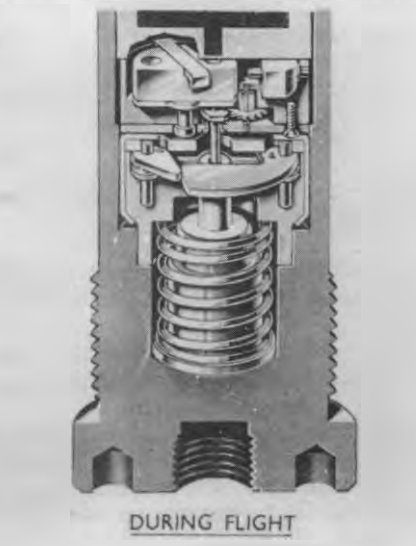
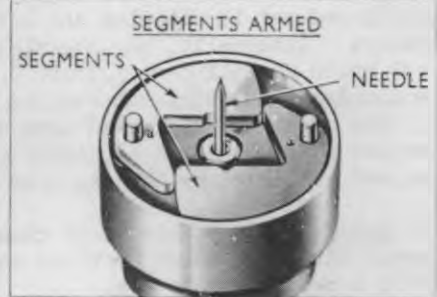


FIG. 60

FUZE, PERCUSSION, BASE, MEDIUM, L15. A1



ACTION OF No.3 DELAYED ARMING SHUTTER



115. Segment spring - These are of 0.022 tinned steel wire, with 6.2 close wound coils, the ends of the wire being bent up at right angles to the coils. These are assembled over the pivot pins and underneath the segments, the lower end of the spring fitting into a small hole drilled in the holder adjacent to the pin, whilst the upper end of the spring is located in a small hole drilled in the segment.

116. Washer - This is of aluminium alloy, in the form of a flat disc with a hole formed in the centre, and two slots diametrically opposite near the periphery.

It is assembled on top of the holder, the protruding ends of the pivot pins being located in the slots, and the point of the needle protruding through the central hole.

117. Cover - This is of aluminium alloy, formed with a large hole in the centre. It fits over the top of the holder and retains the washer in position above the segments. It is secured in position by spinning the bottom edge over around the external chamfered portion of the holder.

118. Delayed arming shutter - This consists of a rotary type shutter containing a 2.8 grain "AZ" detonator assembled in a circular shaped shutter body. The shutter is held in the "unarmed" position by means of a spring-loaded safety plunger which engages in a locking plate. The safety plunger is retained in a recess in the side of the shutter body of a plunger retaining strip. On spin, the safety plunger disengages by centrifugal force and the shutter rotates until the detonator is in a central position over the striker hole. The locking plate, which fits into a slot made across the face of the shutter, moves out and engages in a recess made in the outer side of the shutter body, thus locking the shutter in the "armed" position. The delay is obtained by means of a pellet and pinion mechanism positioned beneath the shutter and this oscillates a segment by means of a 'scape wheel and pinion which retards the opening of the shutter. The approximate time of arming is 0.02 to 0.055 seconds from the time the shutter commences to open.

The D.A. shutter assembly is assembled in the fuze body below the magazine. It is located and prevented from revolving by a screw inserted through the side of the fuze body which enters a slot formed in the side of the shutter body. It is further secured by a screw inserted through the side of the fuze body, the stem of which enters a hole drilled in the side of the shutter body. The threads of both screws are coated with cement, and the thread is stabbed after screwing home. The slotted end of the screws is then coated with cement.

119. Magazine - This is of aluminium alloy - anodised all over. It is cup-shaped and screw-threaded externally commencing at the mouth for about two-thirds of its length, the remaining portion being slightly reduced in diameter and left plain. Two key slots are formed in the outer rim to facilitate assembly. Internally, the magazine is bored out to take a prepressed pellet of C.E. and a small recess which is filled with loose C.E. stemmed in, is drilled in the centre at the bottom, leaving a thin diaphragm of metal between the recess and the outer surface at the base of the magazine.

The magazine is screwed into the open end of the fuze body, the base of the magazine resting above the delayed arming shutter. The outer end of the magazine protrudes above the body of the fuze, and is closed by the magazine cap.

120. Magazine cap - This is of aluminium alloy - anodised all over. It is cup-shaped with an internal thread to screw over the mouth of the magazine, the threads being coated with RD 1285 or RD 1285 A prior to assembly.

121. Safety arrangements - The following safety arrangements are incorporated:-

- (a) Creep spring between flange on striker and base of striker locking segment.
- (b) Striker locking segment
- (c) Rotating delayed arming shutter retained in the safe or unarmed positioned by a spring-loaded centrifugal safety plunger.

122. On leaving the muzzle - Centrifugal force sets in motion the mechanism of the delayed arming shutter and also causes the segments in the striker locking assembly to move outwards, leaving a clear passage for the striker to move forward.

After a pre-determined time the D.A. shutter moves into the correct position for the detonator to be directly above the point of the striker. In this position the fuze is "armed".

123. On impact - The momentum of the striker causes it to set forward compressing the striker creep spring, and permits the point of the needle to pierce the detonator. The resultant flash is communicated to the C.E. pellet in the magazine via the stemmed C.E. in the recess above the diaphragm, and then passes on to detonate the H.E. charge in the shell.

124. Differences in marks - The following shows briefly the various differences in patterns:-

Model A1

(described above)

A limited number only of these fuzes stamped L15A1 were produced and these were manufactured prior to the drawings being sealed.

Model A2

This is similar to the model A1 differing chiefly in the under-flange of the striker being chamfered and minor modifications introduced to obviate damage to the striker points during assembly. These modifications were incorporated in the drawing at the time of sealing.

FUZE, PERCUSSION, D. A. NO. 162

125. Type Direct action, percussion

126. Mortars Mark 1 }  
Mark 1/2 } 3 inch mortar  
Mark 1/3 }  
Mark 4 }

Mark 3 }  
Mark 3/1 } 4.2 inch mortar  
Mark 3/2 }  
Mark 3/3 }  
Mark 5 }

127. Nature of bombs H.E. and smoke W.P., C.S.A.M. and F.M.

128. Description - Mark 3/3 (Fig. 61)

129. General - The fuze consists principally of a body, striker with spring, retaining ball and safety pin; shutter with spring, hinge pin, detonator, detent with spring, steel disc, septum, magazine, cap and safety cap.

130. Body - This is of zinc alloy and at its upper part has a camelure formed to accommodate the cap and below this it is screw-threaded externally for engagement of the safety cap. A tommy hole is formed through the threads for fixing purposes. About the centre a flange is formed below which the body is screw-threaded (R.H.) to 1.375 inch diameter to suit the fuze hole of the bomb, after which the remainder of the body is formed plain. Internally, it is formed with a number of recesses to house the integral parts of the fuze. Detent and shutter inspection holes are drilled through the side of the body and closed by grub screws.

131. Striker - This is of all steel, the lower end being formed pointed to pierce the detonator, and the upper end having a circular flat head slightly below which is formed a coned flanged portion to accommodate the retaining ball when the fuze is unarmed. It is zinc plated all over.

132. Striker spring - This is of coiled steel wire the last coil at each end being laid flat. It is assembled beneath the flange on the striker and raises the striker in the armed position when the detent sets back and the ball drops into the oblique recess in the fuze body.

133. Detent - This consists of a short anodised aluminium alloy rod, the top end of which is chamfered. It rests on top of the detent spring and is retained in the body by cameluring on of the cap.

134. Detent spring - This is a cylindrical coiled steel wire spring and is assembled under initial compression below the detent.

135. Shutter - This is pear-shaped and pivots on a brass hinge pin, the large end being recessed to accommodate the detonator which is retained in position by a washer and secured by turning over a burr formed on the shutter.

136. Shutter spring - This is a coiled steel wire spring having two arms, one of which engages in the recess in the side of the shutter the other bearing against the side of the fuze body. When the point of the striker is raised by the action of the striker spring, the shutter rotates to the armed position so that the detonator is positioned directly under the point of the striker.

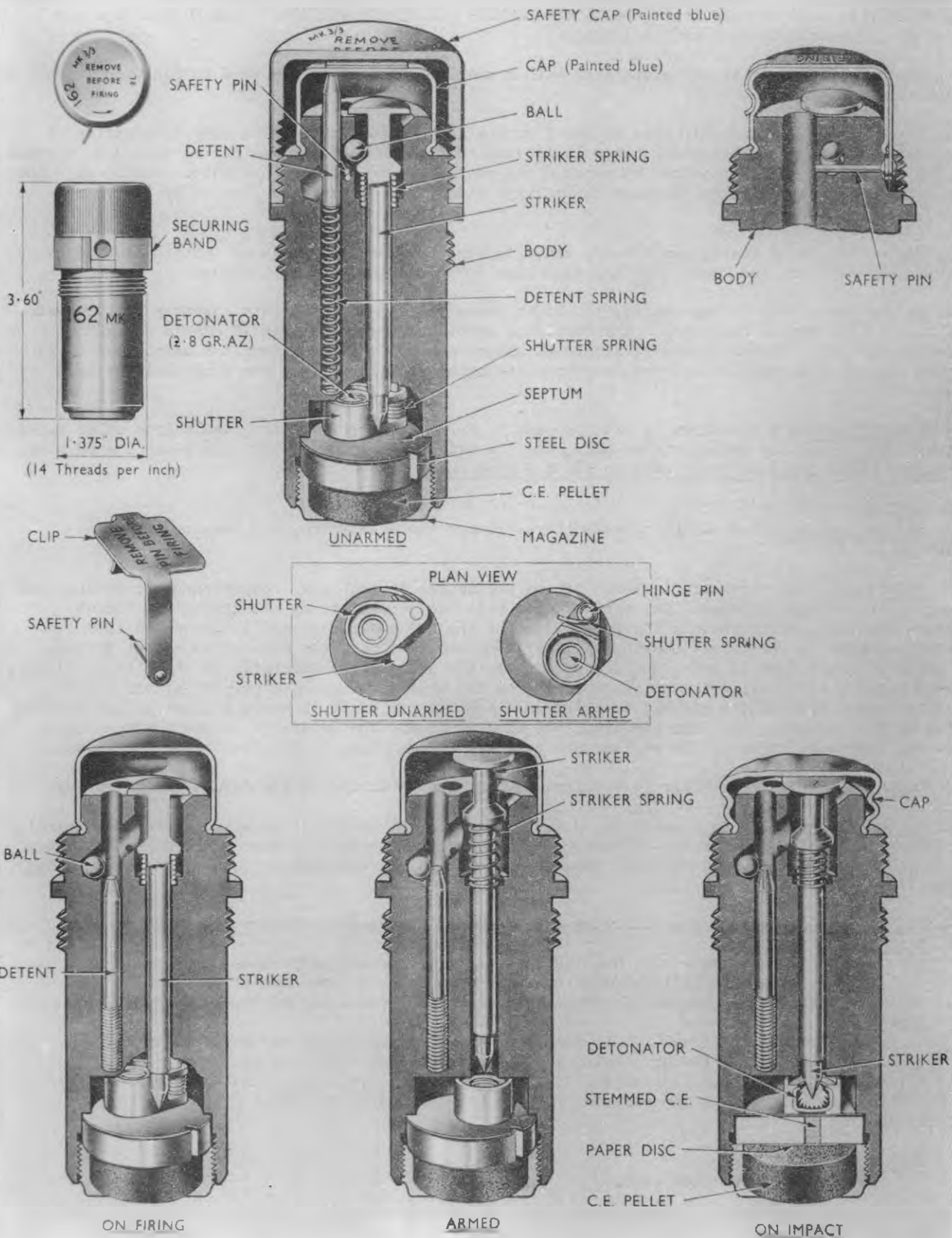
137. Detonator - This consists of a copper alloy shell tinned all over containing 2.8 grains of "AZ" detonating composition pressed in, above which is assembled a paper disc and tinned brass washer, these being secured by turning over the lip of the shell.

138. Magazine - This is of zinc-alloy, cup-shaped and screw-threaded externally to suit the lower end of the fuze body, two key slots being formed on the base to take an assembly tool. The cavity takes a C.E. or pentolite pellet.

139. Ball - This is a standard 0.1875 inch steel ball bearing and is coated with lanoline. It is assembled partly in the oblique channel formed near the head of the fuze body and partly above the chamfer formed on the flange of the striker stem. It is retained by the detent and the safety pin.

FUZE, PERCUSSION, D.A., No.162, MARK 3/3

FIG.61



140. Safety pin - This is made in two pieces, a pin which is riveted to a clip. The pin portion is inserted in a hole drilled below the cannellure formed in the fuze body, the clip attached thereto fitting over the top of the cap. The pin is positioned between the detent and ball and prevents the ball moving should the detent momentarily set back on impact when dropped from aircraft. The clip which fits over the cap bears the legend "REMOVE PIN BEFORE FIRING". The head of the pin is sealed in the fuze body with mark 6 luting.

141. Septum - This is a tinned-plate disc with a small recess cut in the side to position it when assembled above the steel disc.

142. Disc - This is a circular disc of steel with a small recess cut in the side to position it when assembled above the magazine. A hole is drilled through the disc and filled with C.E. stemmed in, the composition being retained by paper discs shellacked to both top and bottom surfaces. The hole filled C.E. is positioned beneath the striker point and is separated from it by the thin tinned-plate septum.

143. Cap - This is of brass, cup-shaped, and fits over the nose of the fuze. It is secured by pressing the metal at the mouth into the cannellure formed in the head of the fuze.

144. Safety cap - This is cup-shaped, the sides being knurled to facilitate assembly and removal. It fits over the top of the fuze. A directional arrow and the words "REMOVE BEFORE FIRING" appear on the top. After assembly, a band of adhesive tape is wound around the safety cap overlapping the joint between it and the fuze body, it being so affixed that the Tommy hole is left clear.

145. Identification - The marks 3, 3/1, 3/3 and 5, No. 162 fuzes are identifiable from other marks by the walls of the cap being painted blue, and the external surface of the safety cap coated blue. The use of these fuzes is restricted to the 4.2 inch mortar.

146. Action

Before loading - Unwind the adhesive tape, remove the safety cap, and then remove the safety pin.

147. On firing - The shock of discharge causes the detent to set back, compressing its spring, and unmasking the oblique recess. The striker also sets back, compressing its spring and thereby releases the ball, which travels the full extent of the oblique recess and is prevented from further movement by the detent bearing against it by the action of the reasserted detent spring. The striker is now free to move, and its spring bearing against the underside of the striker flange, asserts itself, withdrawing the striker point from the shutter recess and permitting the shutter, under the compulsion of its spring, to swing on the hinge pin until it bears against a flat portion of the shutter recess. In this position, the fuze is armed, the detonator in the shutter being below the withdrawn point of the striker and over the stemmed C.E. in the disc below the septum.

148. During flight - The striker is retained in the armed position by the action of its spring.

149. On impact - The cap is crushed in on to the head of the striker, the spring being compressed and the striker point pierces the detonator. The resulting detonating wave penetrates the septum to the C.E. stemmed in the steel disc, thence to the pellet in the magazine and on to the bursting charge in the bomb.

150. Differences in marks - The following shows briefly the various differences in patterns:-

Mark 1

Generally similar to the No. 152 fuze differing principally in having a split pin inserted below the ball to prevent arming when dropped from aircraft. Attached to the split pin is a length of tarred whipcord with a label marked "TO BE WITHDRAWN BEFORE FIRING".

In production after 24.11.44 the label and whipcord becket was replaced by a brass tab attached to the split pin, the circular part of which was bent over the top of the cap and held in position by screwing on the safety cap. Embossed in 1/8th inch lettering on the circular portion were the words "WITHDRAW PIN BEFORE FIRING."

Mark 1/1

Design not proceeded with.

Mark 1/2 (obsolescent)

This design has been introduced to improve waterproofing of the fuze and differs from the mark 1 in being fitted with a new pattern safety pin and clip in lieu of a split pin and brass tab. The head of the pin is sealed in the fuze body with mark 6 luting.

NOTE: The safety pin in the mark 1/2 fuze is of solid wire with the brass tag riveted to the head of the pin. On withdrawal, the brass tag sometimes breaks off, leaving the pin in the fuze. To avoid accidents, pending re-design of the safety pin, the following precautions will be taken:-

During training. if the brass tag breaks off leaving the safety pin in the fuze, the pin will be withdrawn by the use of pliers, and the bomb will be fired. On no account will the fuze be re-pinned or the bomb re-packed. If it proves impossible to withdraw the pin, the bomb will be set aside for destruction.

During operations. if the brass tag breaks off leaving the safety pin in the fuze, then, whenever possible either the pin will be withdrawn by the use of pliers and the bomb will be fired, or the bomb will be fired with the pin in position. Should neither of the above courses be possible, the bomb will be marked for subsequent destruction.

On no account, will fuzes be re-pinned or the bombs re-packed.

Mark 1/3

Differs from earlier marks in that it incorporates a new pattern body which is provided with detent and shutter inspection holes and a shutter designed to accommodate a 2.8 grain tinned "AZ" detonator. It is also fitted with a steel disc in lieu of a zinc alloy, brass or steel disc which may be used as alternatives in mark 1/2 fuzes.

Mark 2

Indian design.

Mark 2/1

Design not proceeded with.

Mark 2/2

Indian design.

Mark 3 (obsolescent)

Differs principally from the mark 1 in that it incorporates an aluminium detent, steel striker, and zinc alloy disc, and a 5 grain "AZ" detonator.

Mark 3/1 (obsolescent)

Similar to the mark 3 but incorporates a 5.7 grain tinned "AZ" instead of a 5 grain "AZ" detonator.

Mark 3/2 (obsolescent)

Similar to the mark 3/1 but incorporates a modified body having inspection holes for detent and shutter.

Mark 3/3

Similar to the mark 3/2 but embodies a modified shutter to accommodate a 2.8 grain tinned "AZ" detonator, and is fitted with a steel disc in lieu of the zinc alloy disc as in the marks 3, 3/1 and 3/2 fuzes.

Mark 4

Similar to the mark 1/3 pattern differing only in that the shutter hinge pin is tin-plated.

Mark 5

Similar to the mark 3/3 pattern differing only in that the shutter hinge pin is tin-plated.

FUZE. PERCUSSION. L.16

151. Type Base percussion
152. Rocket launcher Launcher, Rocket, 3.5 inch U.K. M.20, Mark 2
153. Nature of rocket 3.5 inch U.K. M.20, Mk. 2
154. Description - Model A1 (Figs. 62 and 63)

155. General - This fuze is a base percussion type functioning with non-delay action on impact.

It consists principally of a body, plug, magazine, sealing disc, plunger, creep spring, actuating sleeve, set-back sleeve, striker, shutter assembly, detonator, stop screw, locking pin and spring, ejection pin and safety band.

156. Body - This is of aluminium alloy, anodised all over. It is cylindrical in shape with an external diameter of 2 inches. Internally, a shoulder is formed towards the rear of the body on which seats an aluminium disc, and beyond the shoulder the body is screw-threaded to receive a body closing adapter on to which is screwed the rocket motor. The front portion of the body is threaded internally at the mouth to accept a plug into which is screwed the magazine.

In the side of the body a slot is cut for the ejection pin and adjacent to it a hole is drilled and threaded for a stop screw. Opposite to the slot for the ejection pin a recess is made to house the locking pin and spring which are retained in the recess by a small screwed plug. Adjacent to the locking pin, another pin is inserted through the side of the fuze body to locate the shutter assembly and prevent it revolving.

157. Plug - This is of aluminium alloy, anodised all over. It is cylindrical in shape and threaded externally to partially screw into the front of the body and partially to engage in the screw-threads in the rocket head. Internally, it is recessed on two diameters, the larger being screw-threaded to accept the magazine; the smaller, leaving a thin diaphragm of metal between the base of the recess and the outer surface at the base of the plug, is filled with loose C.E. stemmed in. Two key holes are drilled in front to facilitate assembly.

158. Magazine - This is of aluminium alloy, anodised all over. It is cup-shaped, and is threaded externally to screw into the plug. Internally, it houses the C.E. pellet. Two flats are formed on the base to facilitate assembly into the plug.

159. Sealing Disc - This is a dished disc of aluminium alloy, anodised all over. It is assembled into the rear of the body, the rim being flattened by pressing it onto the shoulder formed in the body.

160. Plunger - This is of brass, zinc-plated all over. It is cone-shaped with a flange formed at the rear. It is housed inside the body, the flange resting against the inner side of the shoulder formed towards the rear of the body.

161. Creep spring - This is a cylindrical coiled tinned steel wire spring, formed with 2.1/2 effective coils of .02 inch diameter wire, one coil at each end being close coiled and square with the axis of the spring. It is assembled around the actuating sleeve.

162. Actuating sleeve - This is of steel, zinc-plated all over, cylindrical in shape and formed with a small external flange at the rear. About the centre a longitudinal slot is formed and three slots are cut in the forward end. It is assembled around the plunger.

163. Set-back sleeve - This is of steel, zinc-plated all over, and cylindrical in shape. A longitudinal and a radial slot are cut in one side. It is assembled over and around the actuating sleeve.

164. Striker - This consists of a zinc-plated steel pin, formed with a needle point above which is a flange and a shank; a flat double phosphor bronze spring and a steel triangular shaped plate lever, formed with a lug each side. The pin is riveted to the centre of the apex of the lever and to one end of the spring.



165. Shutter Assembly - This comprises a shutter plate, shutter, shutter spring, shutter retaining spring, shutter spring pin, shutter hinge pin and shutter retaining spring pin.

The shutter plate, is a flat circular disc, with a slot formed on the outside to fit over a locating pin inserted through the side of the fuze body adjacent to the locking pin. The end of this pin positions the plate and prevents it rotating. The front surface of the plate is cut away and shaped to act as a guide for the shutter and around the periphery a slot is made to accommodate the retaining spring. The shutter hinge pin, shutter spring pin and shutter retaining spring pin are also assembled in the front surface of the plate. The rear surface of the plate is recessed leaving a small portion of metal to act as a stop to the shutter when in the armed position.

The shutter which is a flat, irregular shaped component has a hole drilled through the centre, the rear portion of the hole being enlarged to house the detonator. On one side near the detonator recess, are two small pins. These pins bear against the side of the ejection pin which, when ejected, allows the shutter, under the influence of the shutter spring to swing into the armed position thereby bringing the detonator over the point of the striker. The shutter is assembled over the hinge pin on which it pivots and is moved into the armed position, when the ejection pin is ejected, by a double armed spring which is assembled under tension over a pin positioned to one side of the shutter plate, one arm of the spring bearing against the side of the shutter, the other bearing against the side of the shutter plate. When in the armed position a shoulder on the shutter locks behind a turned over projection on the free end of the shutter retaining spring.

166. Detonator - This is a tinned lugless 2.8 grain "AZ" detonator, and it is assembled with the open end towards the striker. It is assembled in a recess formed in the shutter and is held in position by a retaining washer which is secured by burring over an upstand form around the recess.

167. Stop screw - This is of steel, zinc-plated all over, the head formed with a screw-driver slot. It is assembled in the side of the body and acts as a guide for the set-back sleeve and a stop for the actuating sleeve.

168. Locking pin and spring - The pin is of brass, zinc-plated all over, and formed with a flange around the centre. It is assembled in the side of the fuze body, followed by a small cylindrical coiled steel wire spring, and is retained in the fuze body by a small screwed plug.

169. Ejection pin - This is of steel, zinc-plated all over. It is formed from square bar, with a number of steps or keyways. A dome-shaped cup is welded to the outer end and houses one end of a coiled steel wire ejection spring when the pin is assembled in the fuze. The ejection pin passes through the fuze body and is held in position by the safety band which encircles the body. This pin prevents any movement of the internal parts during storage, transit and handling, it also retains the shutter in the "unarmed" position, thus precluding any accidental functioning.

170. Safety band - This is of steel, zinc-plated all over. It is formed from flat spring strip, hinged in the centre, the ends being fitted with a loop and engaging lever for securing purposes. The band is painted green and printed in red on one side are the words "SAFETY BAND - NOT TO BE REMOVED UNTIL ROCKET HEAD HAS BEEN LOADED INTO LAUNCHER". On the side opposite to the legend is a raised boss around the underside of which is fitted a neoprene washer, which is retained by lugs being turned over on to the outer edges.

171. Action - The safety band is not removed until just prior to the rocket head being finally pushed home into the launcher, and under the influence of its spring the ejection pin moves out from the safe position to the locked position. The fuze cannot arm when the ejection pin is in either of the two positions.

As the rocket enters the launcher, the ejection pin is depressed by the side of the launcher into the intermediate position. The set-back sleeve is then free to move on firing. It will be noted that at this moment the fuze is still safe since the ejection pin prevents movement of the actuating sleeve, firing pin, and shutter.

If it becomes necessary to remove the rocket from the launcher, the ejection pin will move outwards and re-engage the set-back sleeve thus returning the fuze to its locked position. The safety band should then be replaced thereby returning the ejection pin to the original safe position.

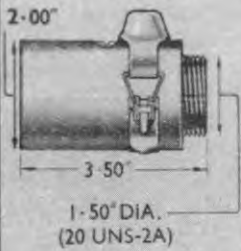
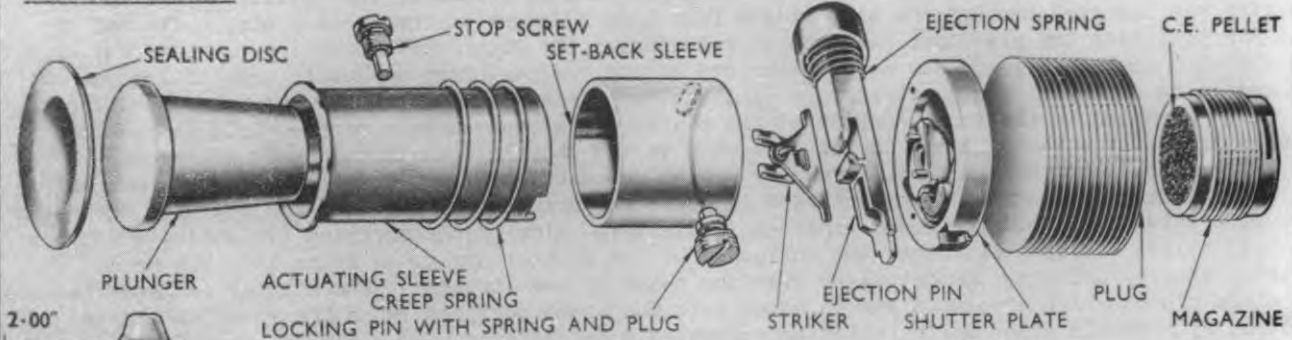
172. On firing - The force of set-back opposing the action of the creep spring moves the set-back sleeve to its rearward position where it is retained by the locking pin.

When the rocket leaves the muzzle of the launcher, the ejection pin is thrown clear of the fuze, the shutter revolves under the influence of its spring, and becomes locked in the armed position by a shoulder on the shutter becoming locked behind a projection on the end of the shutter retaining spring. The fuze is thus fully armed.

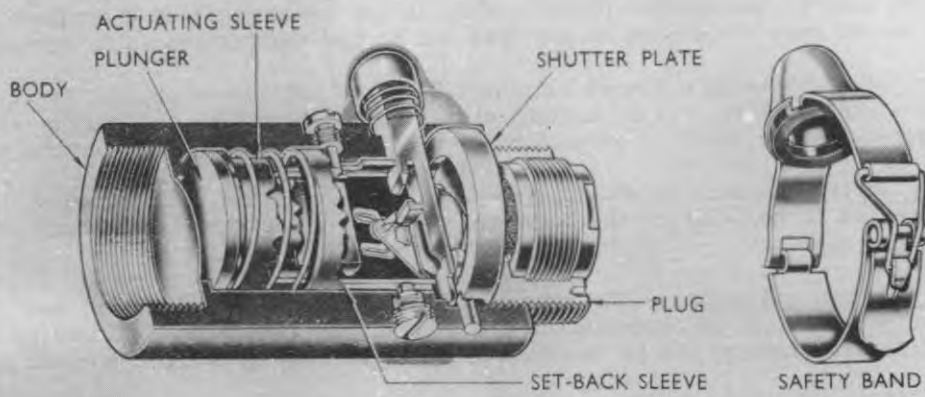
### FUZE PERCUSSION, LI6A1. (part I)

FIG. 62

#### COMPONENT PARTS

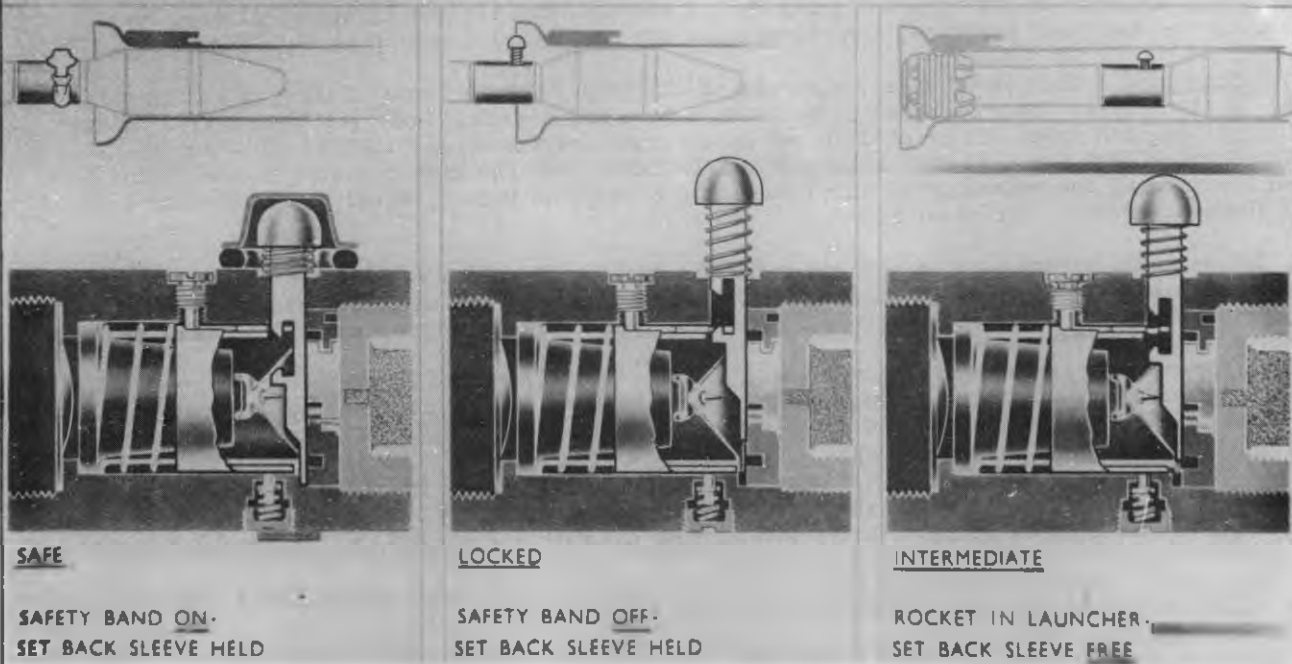


#### GENERAL ASSEMBLY



#### ACTION

LOAD INTO LAUNCHER AND REMOVE SAFETY BAND



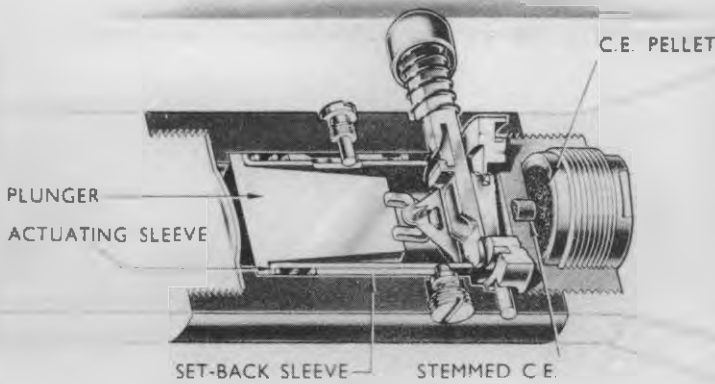
# FUZE PERCUSSION, L16A1. (part 2)

FIG. 63

## ACTION

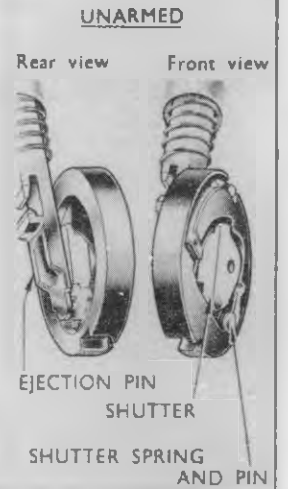
ON FIRING-

UNARMED



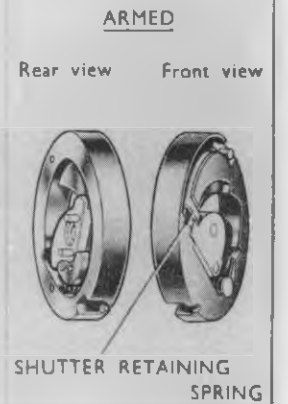
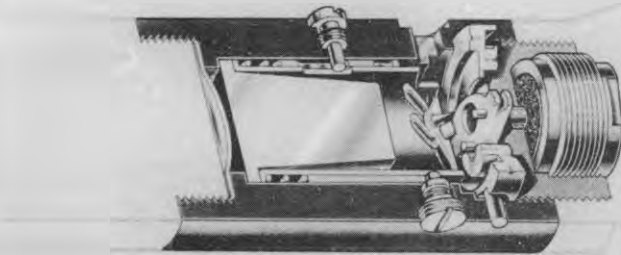
ACTION OF STRIKER

ACTION OF SHUTTER

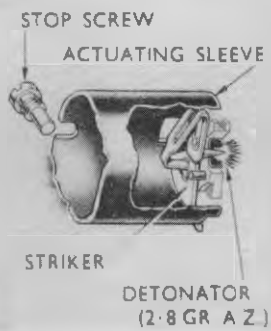
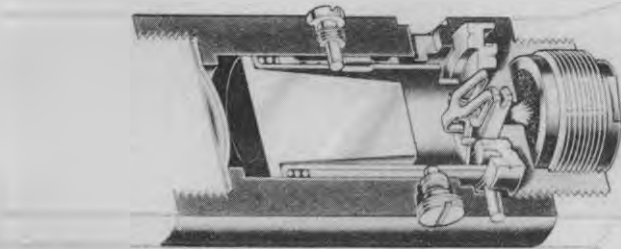


DURING FLIGHT-

ARMED



ON IMPACT



173. During flight - The set-back sleeve and the actuating sleeve are prevented from rotating by the stop screw which passes through a slot provided in both sleeves. The striker spring also prevents the striker from impinging on the detonator, and the creep spring retards the forward movement of the plunger and actuating sleeve. The action of the creep spring is strong enough to retard the plunger and actuating sleeve and to prevent the fuze from firing should the rocket strike a light object such as light brush or undergrowth.

174. On impact or graze - With a more resistant object the inertia plunger and actuating sleeve overcome the force of the creep spring and move forward. The actuating sleeve aided by the weight of the plunger bears on the lugs of the triangular frame on which the striker is mounted. The striker spring is depressed and the striker forced on to the detonator which, in turn, detonates the C.E. pellet in the magazine and the filling in the rocket head.

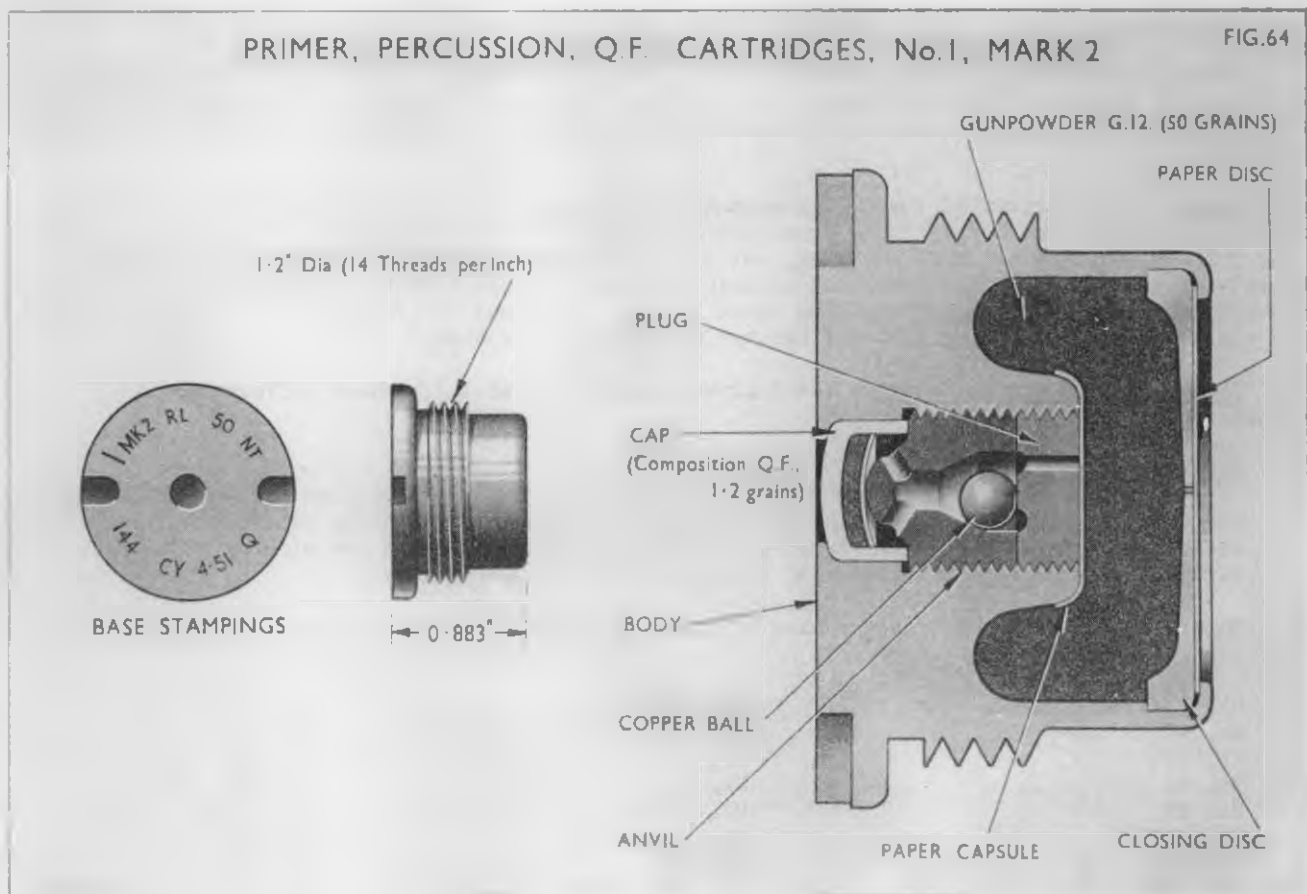
175. Differences in marks - The following shows briefly the various differences in patterns:-

Model A1  
(described above)

## Appendix G Particulars of Primers

PRIMERS, PERCUSSION, Q.F. CARTRIDGES NO. 1

- |  |             |   |                                       |
|--|-------------|---|---------------------------------------|
| 1.                                       | <u>Guns</u> | Q.F. 17 pr.<br>Q.F. 18 pr.<br>Q.F. 13 pr.<br>Q.F. 25 pr.<br>Q.F. 3.7 inch howr. | } <u>Remarks</u><br>For blank charges |
| 2. <u>Description</u> - Mark 2 (Fig. 64) |             |   |                                       |



3. General - The primer consists of a body, cap, anvil, ball, plug and closing disc.  
The joint between the cap and primer body is made waterproof with composition R.D.1229, and the threads of the plug are coated with cement R.D.1158 before assembly (but not the threads of the anvil).
4. Body - The metal body is screw-threaded externally (dia. 1.2 inch 14 threads per inch R.H.) to enter the base of the cartridge case and flanged at the rear to locate it. Two keyways diagonally opposite are formed in the base to take the key No. 193 for inserting and removing the primer.

The interior is bored to accommodate the cap and bored and screw-threaded on a slightly larger diameter to permit the assembly of the anvil and plug. The space between the plug and closing disc forms the magazine which is filled with about 50 grains of G.12 gunpowder.

5. Cap - The copper alloy cap contains approximately 1.2 grains of Q.F. composition pressed in and covered by a lead-tinfoil disc. The cap is housed in the base of the body, being retained in position by the anvil.

6. Anvil - The metal anvil is threaded externally to screw into the primer body. The interior has a parallel, then a coned and a smaller parallel central bore (to house the ball) from whence two fire channels connect to the raised rounded anvil surface at the rear end.

A screwdriver slot is formed in the forward end.

7. Ball - The soft copper ball rests loosely in the coned portion of the anvil.

8. Plug - The metal plug is threaded to engage in the body and bears against the open end of the anvil, thus retaining the ball. The plug has 2 holes drilled through it to form fire channels (prior to September, 1942 the plugs of mark 2 primers were made with 3 fire holes).

A paper capsule is placed over the plug and boss formed in the base of the primer body, and is secured in position by shellac adhesive.

9. Closing disc - The closing disc is of brass, cup-shaped, with 6 radial slits across the centre. An oil varnish paper disc, affixed by its edges, to the outer surface.

After the magazine portion of the body is filled, the closing disc is fitted into the mouth of the body, the edges of which are turned over to retain the disc in position. The exposed surface of the oil varnished paper disc including the turned over joint of the body is then coated with varnish R.D.1219.

10. Action - The striker of the firing mechanism is driven on to the percussion cap and the composition is ripped on the anvil. The flame passes through the fire channels in the anvil, past the ball, through the fire holes in the plug, and through the paper capsule to ignite the gunpowder in the body of the primer. The resultant explosion forces the ball back into its seating, preventing rearward gas escape, by sealing the fire holes in the anvil; and the flame from the magazine forces open the slits in the closing disc and ignites the propellant charge.

11. Particulars of various marks - The following briefly shows the various differences in patterns:-

Mark 2M

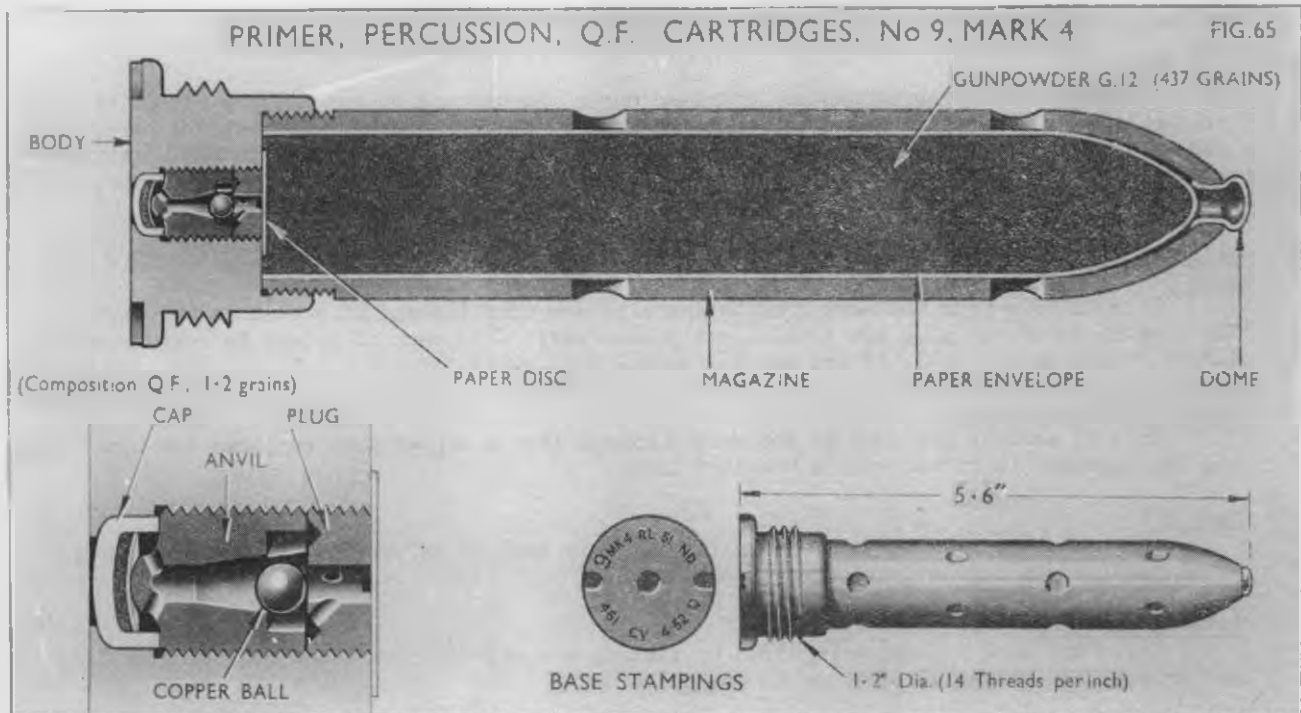
This is the mark 2 primer repaired by fitting a new cap, anvil, copper ball and plug. The base is indented to bring the cap chamber up to the mark 2 and the metal at the mouth is thinned down to facilitate turning over after re-filling, and a new closing disc is fitted. The primer is filled with about 45 grains of G.12 powder

NOTE:- "Q" is stamped on the base of primers assembled with caps filled with Q.F. composition.

Mk. 1	}		Mk. 2RRM	}		Mk. 3B	}	
Mk. 1*			Mk. 2RRMT			Mk. 3R		
Mk. 1RR			Mk. 2RRT			Mk. 3RB		
Mk. 2A			Mk. 2RT			Mk. 3RR		
Mk. 2B			Mk. 2T			Mk. 3RRT		
Mk. 2AB			Mk. 2*			Mk. 3RT		
Mk. 2AT			Mk. 2*B			Mk. 3T		
Mk. 2BT		} Obsolete	Mk. 2*M		} Obsolete	Mk. 4		} Obsolete
Mk. 2MB			Mk. 2*MB			Mk. 4B		
Mk. 2MR			Mk. 2*MR			Mk. 4T		
Mk. 2MRM			Mk. 2*MRT			Mk. 5		
Mk. 2MRMT			Mk. 2*MT			Mk. 6		
Mk. 2MRT			Mk. 2*R			Mk. 6B		
Mk. 2MT			Mk. 2*RT			Mk. 6T		
Mk. 2R			Mk. 2*T			Mk. 7		
Mk. 2RB	Mk. 3							

PRIMER, PERCUSSION, Q.F. CARTRIDGES NO. 9

		<u>Remarks</u>
12. <u>Guns</u>	Q.F. 3.7 inch Mk. 6	Mks. 3/1, 3/2 and 4 only.
	Q.F. 3.7 inch Mks. 1 to 3	Mks. 2, 2M, 2MR, 3, 3MR, 3/1 3/2 and 4 with reduced charges only, and Mks. 3/1, 3/2 and 4 with Ctge. A.P.C., B.C. Shot/T.
	Q.F. 77 mm.	
	Q.F. 17 pr.	Full and reduced charges
	Q.F. 120 mm. L. 1	Mks. 3/2 or 4
13. <u>Description</u> - mark 4 (Fig. 65)		



14. General - The primer consists of a body, cap, anvil, ball, plug, magazine with domed end and a paper envelope.

The joint between the cap and primer body is made waterproof with composition R.D. 1229; the threads of the plug are coated with cement R.D. 1158; and the threads of the magazine are coated with cement R.D. 1242B, before assembly (but not the threads of the anvil).

15. Body - The metal body is screw-threaded externally (dia. 1.2 inch 14 threads per inch R.H.) to enter the base of the cartridge case and flanged at the rear to locate it. Two keyways diagonally opposite are formed in the base to take the key No. 26, 135, 183 and 194 for inserting and removing the primer.

The interior is bored to accommodate the cap and bored and screw-threaded on a larger diameter to permit the assembly of the anvil, plug and magazine.

16. Cap - The copper alloy cap contains approximately 1.2 grains of Q.F. composition pressed in and covered by a lead-tinfoil disc. The cap is housed in the base of the body, being retained in position by the anvil.

17. Anvil - The metal anvil is threaded externally to screw into the primer body. The interior has a coned and a smaller parallel bore (to house the ball) from whence 2 fire channels connect to the raised rounded anvil surface at the rear end.

A key slot is formed in the forward end.

18. Ball - The soft copper ball rests loosely in the coned position of the anvil.

19. Plug - The metal plug is threaded to engage in the body and bears against the open end of the anvil, thus retaining the ball. The plug is bored centrally to form a fire channel and also diagonally to form three smaller fire channels to connect the central main fire channel to an annular groove on the rear face.

A screwdriver slot is formed on the forward end.

A paper disc is affixed by shellac over the other end of the plug and on to the body.

20. Magazine - The cylindrical brass magazine is rounded at the front and screw-threaded externally at the rear to engage in the body. It is perforated with sixteen radial fire holes along the sides and one fire hole in the front end, the latter being closed by a white-metal dome secured in position by pressing over the top. The white-metal dome is provided to prevent accidental perforation of the magazine by a stick of the propellant charge, it also acts as a decoppering agent.

The interior of the magazine is fitted with an envelope of shellacked paper or other approved material which is secured in position by shellac adhesive.

The magazine is filled with 437 grains of G12 gunpowder.

#### ACTION

21. The striker of the firing mechanism is driven on to the percussion cap and the composition is nipped on the anvil. The flame passes through the fire channels in the anvil, past the ball, through the holes in the plug and through the paper disc to ignite the gunpowder in the magazine. The resultant explosion forces the ball back into its seating, preventing rearward gas escape, and the flame passes through the holes of the magazine to ignite the propellant charge.

22. Difference in marks - The following shows briefly the various differences in patterns:-

#### Mark 3

This differs from the mark 4 by having a copper cone instead of a ball in the anvil. The dimensions of the plug are also slightly modified. This mark of primer is restricted to Q.F. 3.7 inch Mk. 1 to 3, 17 pr. and 3.7 inch R.C.L. guns.

#### Mark 3/1 (Obsolescent)

This is exactly the same as the mark 3 except that a copper ball replaces the coned plug, and the magazine is fitted with a "Hawley" liner.

#### Mark 3/2

This is similar to the mark 3/1 differing only that it is provided with a new pattern anvil designed to improve performance and sealing.

#### Marks 3M and 3MR

These are mark 3 primers repaired by fitting new magazine domes and cone plug sealing mechanisms, and slight alterations to the body.

#### Mark 2 (obsolescent)

This differs from the mark 3 only in dimensions of the anvil and cone. The mark 3 is also fitted with a plug of modified design. The plug for the Mk. 2 had two fire holes.

#### Mark 2M and 2MR

These are mark 2 primers repaired as necessary by fitting new anvil, screwed plug, magazine dome, and soft copper coned plug.

#### Mark 1

This differs from the mark 2 by having a copper ball instead of a cone plug, the anvil having a 3.7° conical bore.

#### Marks 1M and 1MR

These are mark 1 primers repaired as necessary by fitting new anvil, screwed plug, magazine dome and ball. The screwed plug had 3 fire holes.

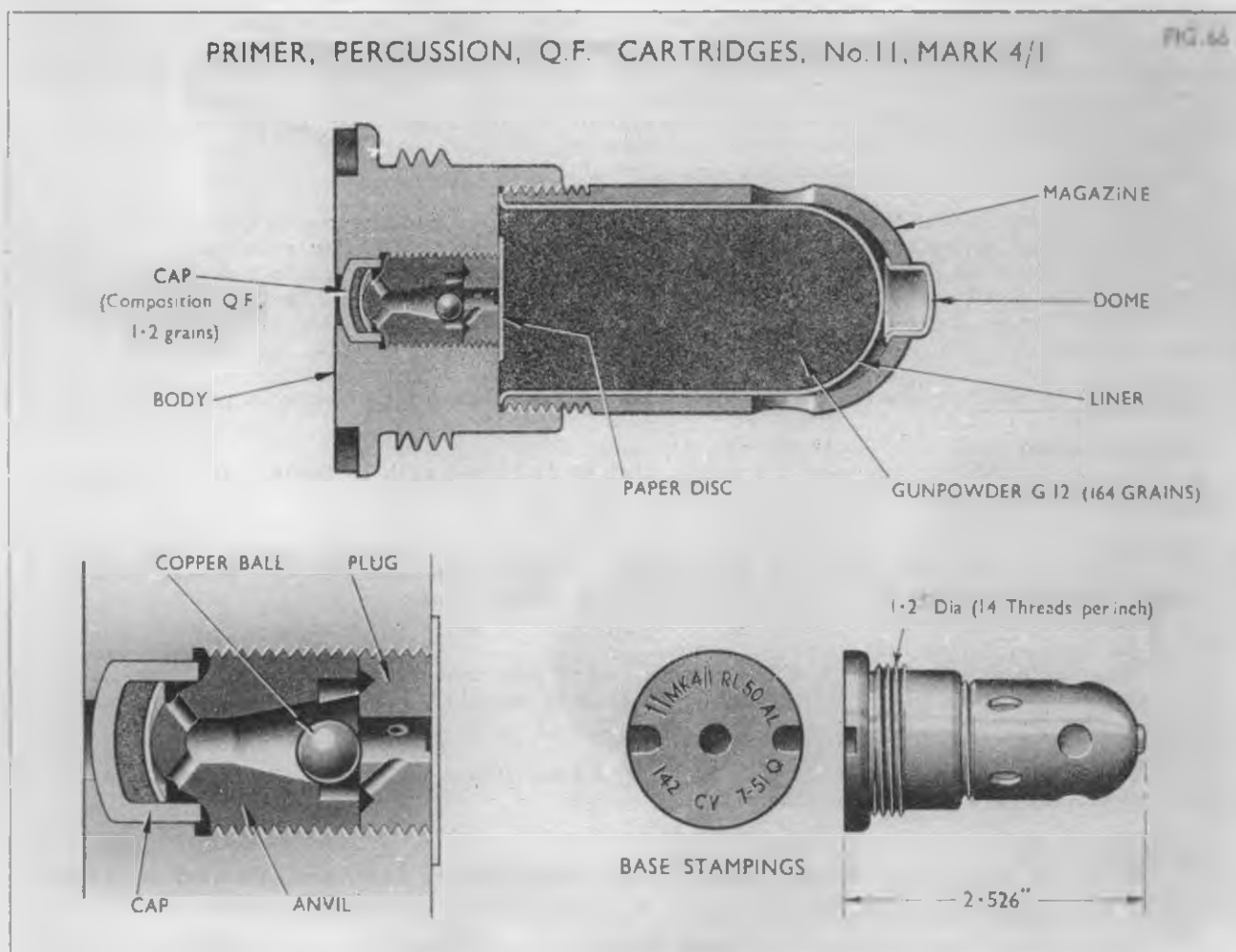
NOTE:- "Q" is stamped on the base of primers assembled with caps filled with Q.F. composition.



PRIMER, PERCUSSION, Q.F. CARTRIDGES, NO. 11

		<u>Remarks</u>
23. <u>Guns</u>	Q.F. 3.7-inch Mks. 1 to 3 Q.F. 77-mm. Q.F. 17-pr. Q.F. 25-pr.	Primers (all marks). Full and reduced charges. Reduced and B.E. smoke Ctges.

24. Description - Mark 4/1 (Fig. 66)



25. General - The primer consists of a body, cap, anvil, ball, plug, magazine with domed end and a liner.

The joint between the cap and primer body is made waterproof with composition R.D. 1229; the threads of the plug are coated with cement R.D. 1158; and the threads of the magazine are coated with cement R.D. 1242B before assembly (but not the threads of the anvil).

26. Body - The metal body is screw-threaded externally (dia. 1.2-inch 14 threads per inch R.H.) to enter the base of the cartridge case and flanged at the rear to locate it. Two keyways diagonally opposite are formed in the base to take the key No. 25 for inserting and removing the primer.

The interior is bored to accommodate the cap, and bored and screw-threaded on a larger diameter to permit the assembly of anvil, plug and magazine.

27. Cap - The copper alloy cap contains approximately 1.2 grains of Q.F. composition pressed in and covered by a lead-tinfoil disc. The cap is housed in the base of the body, being retained in position by the anvil.

28. Anvil - The metal anvil is threaded externally to screw into the body. The interior has a coned and a small parallel bore (to house the ball) from whence 2 fire channels connect to the raised rounded anvil surface at the rear end. A key slot is formed in the forward end.

29. Ball - The soft copper ball rests loosely in the coned portion of the anvil.

30. Plug - The metal plug is threaded to engage in the body and bears against the open end of the anvil, thus retaining the ball. The plug is bored centrally to form a fire channel and also diagonally to form three smaller fire channels to connect the centre main fire channel to an annular groove on the rear face. A screwdriver slot is formed on the forward end.

31. Magazine - The magazine is cylindrical, rounded at the front and screw-threaded externally at the rear to engage in the body. It is perforated with eight radial fire holes along the sides and one fire hole in the front end, the latter being closed by a white-metal dome secured in position by slightly pressing over the top. The white-metal dome is provided to prevent accidental perforation of the magazine by a stick of the propellant charge, it also acts as a decoupling agent.

The interior of the magazine is fitted with a liner of shellacked paper or other approved material which is secured in position by Shellac Adhesive.

The magazine is filled with about 164 grains of G 12 gunpowder.

32. Action - The striker of the firing mechanism is driven on to the percussion cap and the composition is nipped on the anvil. The flame passes through the fire channels in the anvil, past the ball, through the fire holes in the plug and through the paper disc to ignite the gunpowder in the magazine. The resultant explosion forces the ball back into its seating in the anvil, preventing rearward gas escape, and the flame passes through the holes in the magazine to ignite the propellant charge.

33. Difference in marks - The following shows briefly the various differences in patterns:-

Mark 4 (Obsolescent)

This is similar to the mark 4/1 except that it is fitted with a "Hawley" liner which is now obsolete.

Mark 3/2

These are empty Mk.3 primers which at time of filling are assembled with a ball instead of the original cone plug, and are fitted with a polythene liner.

Mark 3

This differs from the mark 4 in having a copper cone instead of a ball in the anvil. The dimensions of the plug and body are also slightly modified.

Mark 3/1

This differs from the mark 3 only in being fitted with a moulded paper "Hawley" liner (now obsolete) or a moulded polythene liner.

Mark 3M and 3MR

These are mark 3 primers repaired by fitting new magazine, dome, and cone seal mechanism.

Mark 2 (obsolescent)

This differs from the mark 3 in being fitted with a different design of plug and in the dimensions of anvil and cone.

Mark 2M and 2MR

These are mark 2 primers repaired as necessary by fitting new anvil, screwed plug, magazine dome and soft copper cone plug.

Mark 1

This differs from the mark 2 primer in having a soft copper ball instead of a cone plug, and in the anvil being shaped internally to suit the ball.

Mark 1M

This is the mark 1 primer repaired by fitting a new anvil, ball, magazine dome and plug.

Mark 1MR

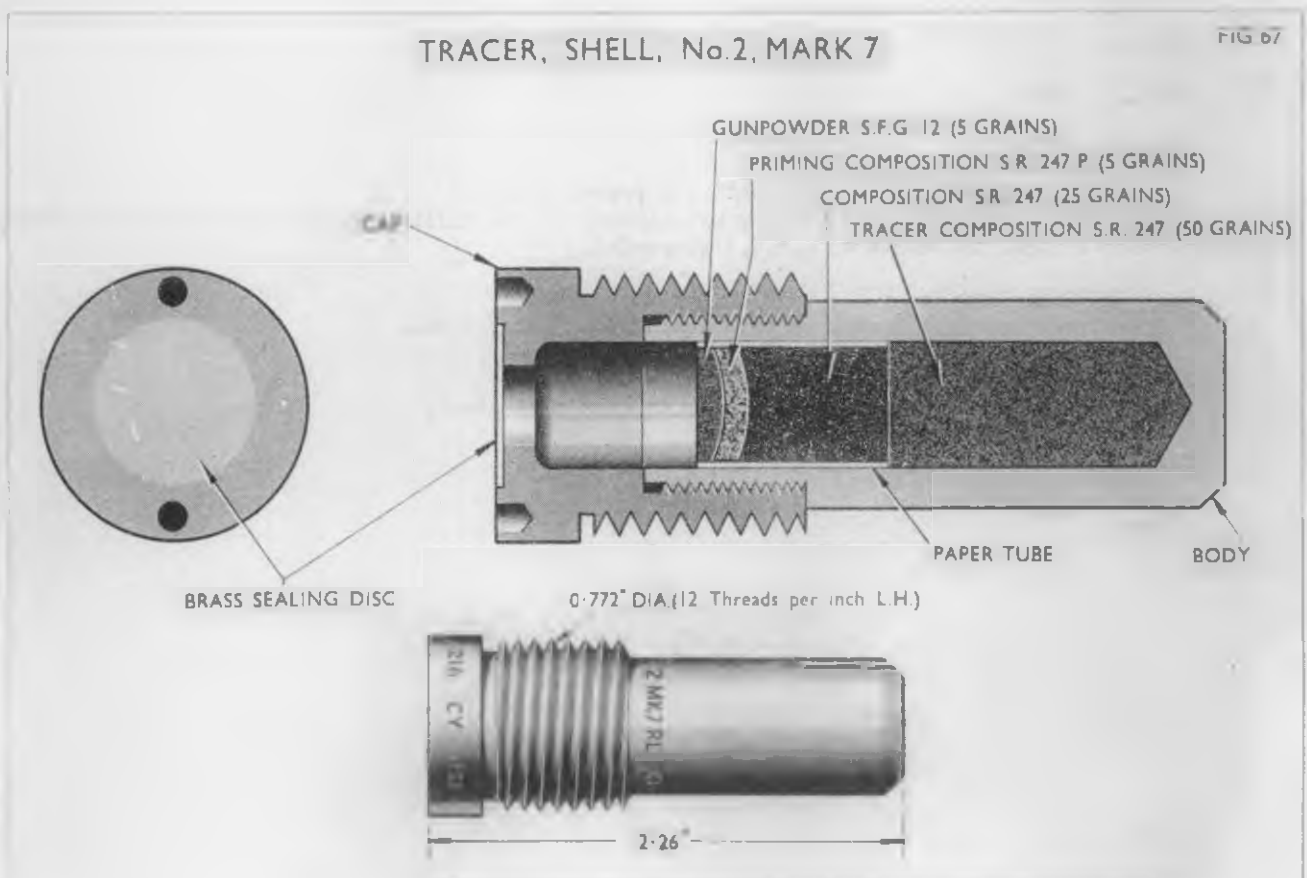
This is the mark 1M primer repaired by fitting a new anvil, ball, magazine dome and plug, the anvil and plug being of increased diameter and the screw-threaded recess in the body being opened out to accommodate them.

NOTE:- "A" is stamped on the base of primers assembled with caps filled with Q.F. composition.

## Appendix H Particulars of Tracers

### TRACER, SHELL, NO. 2

- |  |   |
|--|---|
| 1. <u>Type</u>                           | Day or night, internal                  |
| 2. <u>Gun</u>                            | 25 pr. and 75 mm.                       |
| 3. <u>Projectile</u>                     | For practice shot only                  |
| 4. <u>Colour of trace</u>                | Greenish white, visible approx. 8 secs. |
| 5. <u>Description</u> - Mark 7 (Fig. 67) |   |



6. General - Comprises stocks of empty marks 4 and 6 tracers which consist of a cap, body and brass sealing disc.

7. Cap - This is flanged and screw-threaded externally to fit into the tracer socket of the projectile, internally it is screw-threaded to engage the magazine. Two key holes are formed in the head to facilitate fixing or removing, and a brass disc is sweated into a recess in the face.

8. Body - The body is cylindrical and screw threaded externally at the open end to engage in the cap. Internally it is bored to accommodate the filling which consists of 50 grains of tracer composition S.R. 247 pressed home in two increments, this is followed by a pre-pressed pellet consisting of 25 grains of composition S.R. 247, 5 grains of priming composition S.R. 247P, and 5 grains of S.F.G. 12 gunpowder inserted in a wax impregnated paper tube. The pellet is inserted and pressed in on top of the tracer composition, leaving a space between the final surface of the gunpowder and the recess bored in the cap.

Action:-

9. On firing, the brass disc covering the flash hole in the cap is blown in and the flash from the propellant charge ignites the gunpowder and priming composition which, in turn, ignites the tracer composition. When the projectile leaves the muzzle of the gun, the flame from the tracer composition escapes through the flash hole thus enabling the flight of the projectile to be observed.

10. Particulars of various marks - Various marks have been allocated to this nature of tracer, the main differences between the Land Service patterns are tabulated below:-

Mark 1 Naval. (obsolescent)

Mark 2 Naval. (obsolescent)

Mark 3 Naval. (obsolescent)

Mark 3C Naval.

Mark 4 Land Service. (obsolescent) for practice only.

Mark 5 Naval

Mark 5A Naval

Mark 6 Land Service. (obsolescent) for practice only.

Similar to the mark 4 but differing principally in the filling, the tracer composition being S.R. 261C with a final increment of S.F.G. 2 gunpowder.

Mark 6R Land Service

Differs from the mark 6 only in being made from Ledloy steel.

Mark 6S Land Service

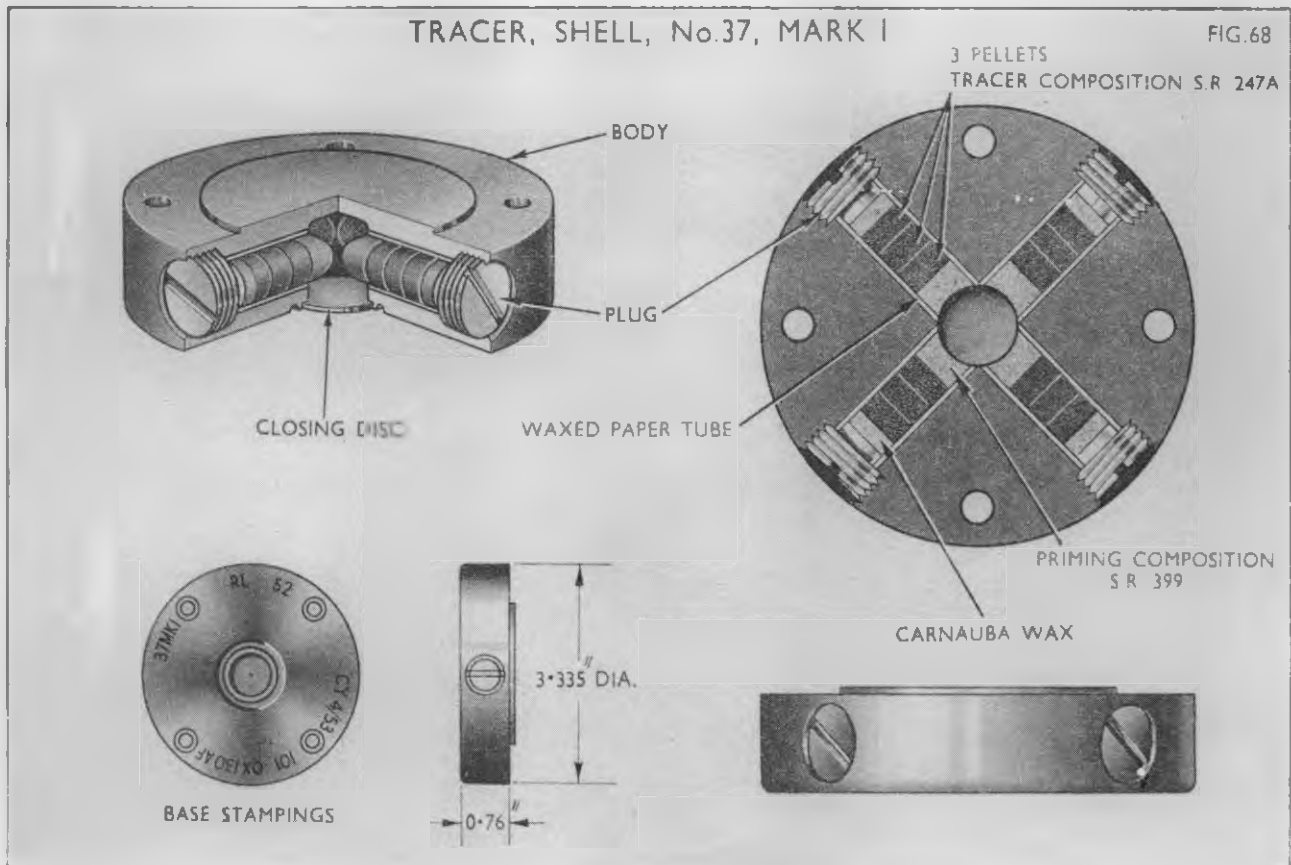
Differs from the mark 6 only in being made from mild steel.

Mark 8 Naval

Mark 9 Naval

TRACER, SHELL, NO. 37

- |   |                      |
|---|----------------------|
| 11. <u>Type</u>                           | Flat base, 4 channel |
| 12. <u>Gun</u>                            | 25 pr.               |
| 13. <u>Projectile</u>                     | HESH                 |
| 14. <u>Colour of trace</u>                | Red                  |
| 15. <u>Description</u> - Mark 1 (Fig. 68) |                      |



16. General - The tracer is made of steel and is in the form of a flat disc. Four holes equally spaced are drilled through the disc to enable the tracer to be affixed by screws to the base of the projectile.

Internally, it is drilled from 4 longitudinally cavities to contain the tracer composition, these cavities terminating in a hole drilled centrally in the base of the trace. The mouths of the cavities are closed, after filling by screw-threaded steel plugs. The central hole formed in the base is closed by a thin brass disc which is secured, after the cavities are filled by turning over a bezel, the disc and bezel being coated with composition R.D.1229. The faces of the 4 plugs and the sealing disc are painted red after filling.

17. Filling - Each cavity is lined with a wax impregnated paper tube into which is inserted (reading from the centre hole) 1 pre-pressed pellet of priming composition S.R. 399 weighing approximately 20 grains, 3 pre-pressed pellets of tracer composition S.R. 372AB each weighing approximately 16 grains, followed by 1 pellet of carnauba wax weighing approximately 5 grains. The screw threads of the plugs are coated with cement R.D.1248, they are then inserted and screwed home.

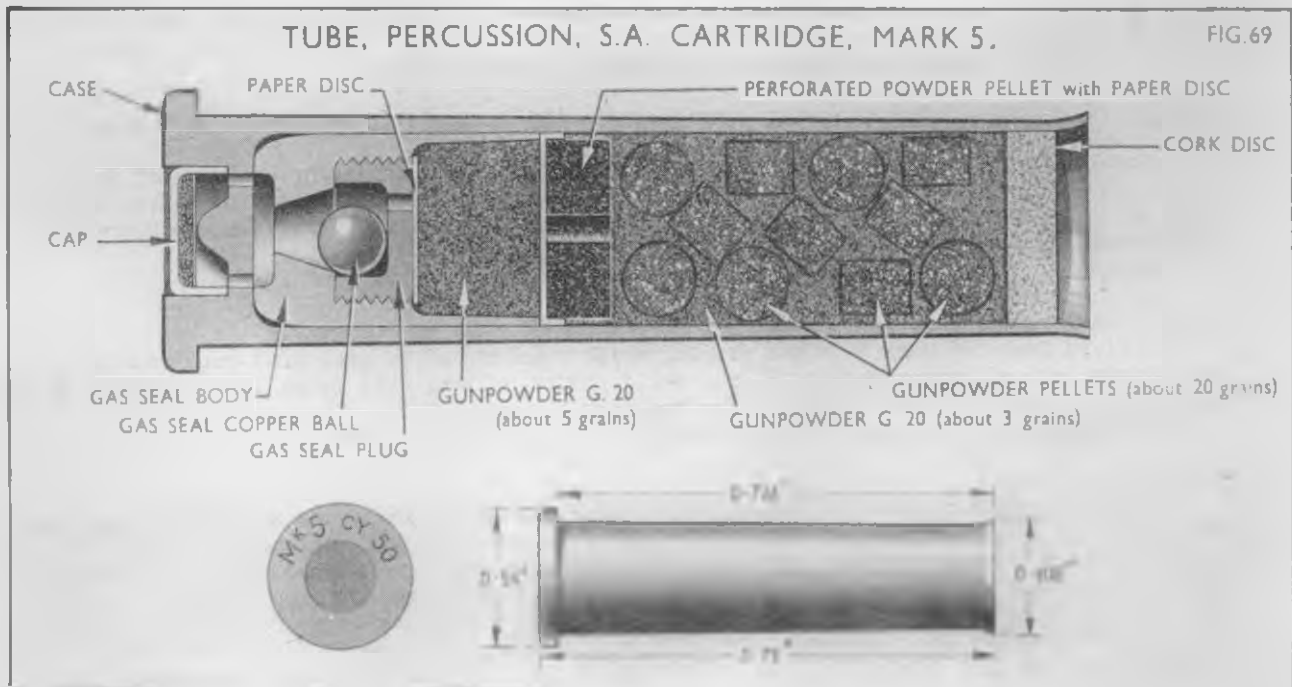
18. Action - On firing, the brass disc over the emission hole in the centre of the base is blown in and the flash from the propellant charge ignites the priming composition in each of the four cavities which, in turn, ignites the tracer composition.

When the projectile leaves the muzzle the flame from the tracer composition in the four cavities escapes through the central emission hole and enables the flight of the projectile to be observed.

## Appendix J Particulars of Tubes

### TUBES, PERCUSSION, S.A. CARTRIDGE

1. Marks 1 and 2 tubes For use with ordnance having suitable firing mechanism except B.L. 4.5 inch gun.
2. Marks 3 to 5 tubes For use with ordnance having suitable firing mechanism i.e.,  
B.L. 5.5 inch gun  
B.L. 4.5 inch gun  
B.L. 7.2 inch howr.
3. Description - Mark 5 (Fig. 69)



4. General - The tube consists of a .303 cartridge case and percussion cap, a gas seal and a cork disc.

The case, of brass, is tapered towards the front end and slightly bell-mouthed. The rear end is formed externally with a flange to prevent the tube being pushed too far into the vent and also to facilitate extraction, and the interior is bored from both ends, leaving a diaphragm towards the rear end.

Two fire holes are drilled through the diaphragm to allow the flash from the cap to reach the magazine, the rear surface of which is shaped with a projection to act as an anvil. In the rear of the anvil a recess is formed to receive a percussion cap. In front of the diaphragm, the interior is shaped to accommodate a gas seal.

The percussion cap, of copper, is cup-shaped and contains 0.5 to 0.7 grs. of detonating composition pressed in and covered by a lead tin-foil disc. The cap is pressed into the cap chamber.

The gas seal consists of a body, plug and ball.

The body, of metal, is shaped externally to suit the recess in the base of the magazine portion of the case. It is bored and screwed internally to receive the plug. Above the recess for the plug a chamber is formed which contains about 5 grs. of G.20 gunpowder, the walls of this chamber being tapered to allow the explosion of the gunpowder to expand the edges against the interior wall of the case, so preventing escape of gas to the rear. Below the recess for the plug the body is bored with a channel to permit the flash from the cap to pass on to the gunpowder, the channel being coned to receive a copper ball.

The plug, of metal, is screw-threaded externally to suit the thread in the body, three fire-holes being bored through from front to rear. The under surface is recessed and formed rectangular in shape to allow clearance for the copper ball.

The ball, of soft copper, is spherical in shape and seals the channel in the body, after explosion of the gunpowder.

A fine white paper disc is secured by shellac to the top of the plug, whilst a perforated powder pellet is secured above the gunpowder by shellac adhesive.

The main magazine of the tube is above the perforated powder pellet and consists of 20 grs. of powder pellets (or alternatively G7 gunpowder) the interstices being filled in with 3 grs. of G.20 gunpowder.

The mouth of the tube is closed with a disc of cork or cork substitute, the disc being coated with varnish before insertion and the exposed side being afterwards waterproofed with approved varnish.

5. Action - When the percussion mechanism is operated, the cap in the base of the tube is struck by the point of the firing pin, causing the cap composition to be nipped between the anvil and the interior base of the cap, and thus fired. The resulting flash passes through the holes in the body diaphragm and plug to ignite the powder in the magazine which, in turn, blows out the cork closing plug and ignites the cloth igniter attached to the base of the propellant charge.

The soft copper ball is driven to the rear by the explosion in the magazine and the walls of the tube are expanded radially so preventing escape of gas to the rear from the tube chamber in the vent. The ball seal prevents internal gas escape through the head of the tube; where this is absent as in the marks 1 and 2, the percussion cap fulfils this function.

6. Differences in marks - The following shows briefly the various differences in patterns:-

Mark 1 (obsolescent)

Consists of a .303 inch brass case with percussion cap, containing a charge of about 50 grs. of solid gunpowder pellets, the mouth of the case being closed by a cork disc or plug which is coated with shellac varnish before insertion, the exposed surface being afterwards waterproofed by shellac. This is a necked tube.

Length 2.222 inch diameter .460 inch under head, .34 inch at mouth.

Mark 2 (obsolescent)

Differs from the mark 1 in the filling which consists of 15 grs. G.20 gunpowder in a paper container and approximately 29 grs. solid powder pellets with loose G.20 gunpowder in the interstices. The mouth is closed as for the mark 1 tube.

The shape and dimensions are the same as for the mark 1.

Mark 3 (obsolescent)

Differs from the mark 2 in the tube not being necked and in having an internal gas seal metal body and plug, with copper ball and in the filling. The gas seal body is bored out and provided with a screwed recess to house the plug, the latter being fitted with a soft copper ball which prevents escape of gas after firing. Three holes are bored in the plug to allow the flash to pass from the cap to the body. The filling consists of approximately 5 grs. of G.20 gunpowder in the top portion of the body with a perforated powder pellet interposed between it and 20 grs. powder pellets (or alternatively G.7 powder) in the brass case, the interstices being filled in with approximately 3 grs. loose G.20 gunpowder.

Length 1.79 inches, diameter .460 inch under head .401 inch at mouth.

Mark 3A (obsolescent)

This is a converted mark 3 tube.

The conversion consists of fitting a modified gas seal plug. The shape and dimensions are the same as for the mark 3 tube.

Mark 4 (obsolescent)

Generally similar to the mark 3 tube differing principally in that the channel in the gas seal to receive the copper ball has a larger chamfer, the ball completely entering the channel improving the sealing effect.

The shape and dimensions are the same as for the mark 3 tube.

Mark 4A

This is a converted mark 4 tube and differs only in that the recess in the plug for the copper ball is rectangular in shape, thus allowing more movement of the ball.

Mark 5

Generally similar to the mark 4A tube, but is of new manufacture.





